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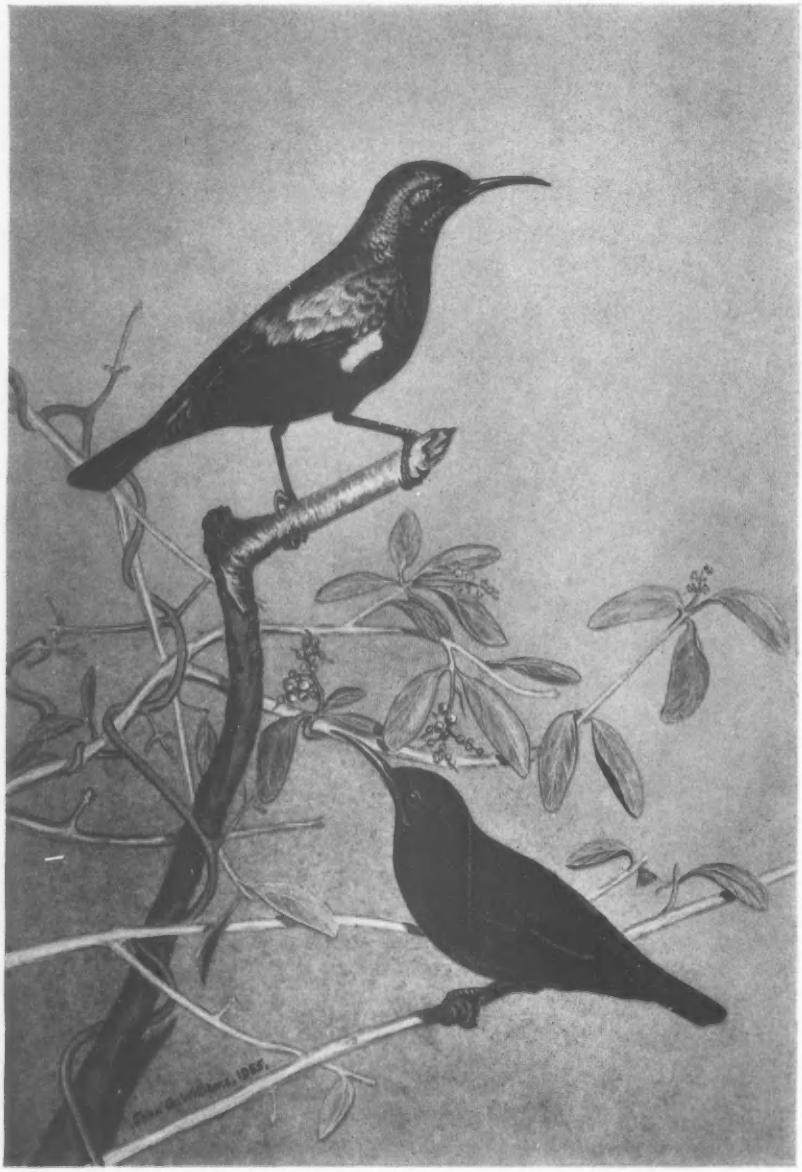

SHINING SUNBIRD
CINNYRIS HABESSINICUS KINNEARI
Adult male and female on *Salvadora persica*.

THE CONDOR

VOLUME 57 SEPTEMBER-OCTOBER, 1955 NUMBER 5

A SYSTEMATIC REVISION AND NATURAL HISTORY OF THE SHINING SUNBIRD OF AFRICA

By JOHN G. WILLIAMS

The Shining Sunbird (*Cinnyris habessinicus* Hemprich and Ehrenberg) has a comparatively restricted distribution in the northeastern part of the Ethiopian region. It occurs sporadically from the northern districts of Kenya Colony and northeastern Uganda northward to Saudi Arabia, but it apparently is absent from the highlands of Ethiopia (Abyssinia) above 5000 feet. The adult male is one of the most brightly colored African sunbirds, the upper parts and throat being brilliant metallic green, often with a golden sheen on the mantle, and the crown violet or blue. Across the breast is a bright red band, varying in width, depth of color, and brilliance in the various races, bordered on each side by yellow pectoral tufts; the abdomen is black. The female is drab gray or brown and exhibits a well-marked color cline, the most southerly birds being pale and those to the northward becoming gradually darker and terminating with the blackish-brown female of the most northerly subspecies.

In the present study I am retaining, with some reluctance, the genus *Cinnyris* for the species under review. I agree in the main with Delacour's treatment of the group in his paper (1944) "A Review of the Family Nectariniidae (Sunbirds)" and admit that the genus *Nectarinia,* in its old, restricted sense, based upon the length of the central pair of rectrices in the adult male, is derived from a number of different stocks and is unsound. Nevertheless, I consider that the merging of these two genera and others does not give a clearer picture of the relationships of the various species, while it does create a genus of unwieldly proportions. I feel that it may be the wiser course to retain genera such as *Cinnyris* and *Chalcomitra* until such time as a complete generic revision can be undertaken, based on extensive spirit and skeletal material in addition to study skins. I may mention that with this end in view I am building up a spirit collection of the African members of the Nectariniidae, which eventually will be available for anatomical study.

Sclater (1930) recognized two races of *Cinnyris habessinicus,* the nominate form and *C. h. hellmayri* Neumann of southwestern Arabia. He regarded *C. h. alter* Neumann and *C. h. turkanae* van Someren as synonyms of *habessinicus.* Another race, *C. h. kinneari* Bates, was described five years after the publication of Sclater's work. It is difficult to understand Sclater's treatment of the species. Even though he lacked extensive series of this sunbird from throughout its range, it is remarkable that he should not have recognized *turkanae,* which is strikingly different from any other race in having a very broad red breast band, and *alter,* which is noticeably large.

During the past few years I have undertaken four expeditions, to the southeastern Sudan, Turkana, Northern Frontier District of Kenya Colony, Italian Somalia, and British Somaliland, with the object of collecting an adequate study series of the southern and Somaliland races of this sunbird and observing its habits in the field. The present study of the status and geographic distribution of the races of *C. habessinicus* is based on 156 specimens, representing all races in all plumages.

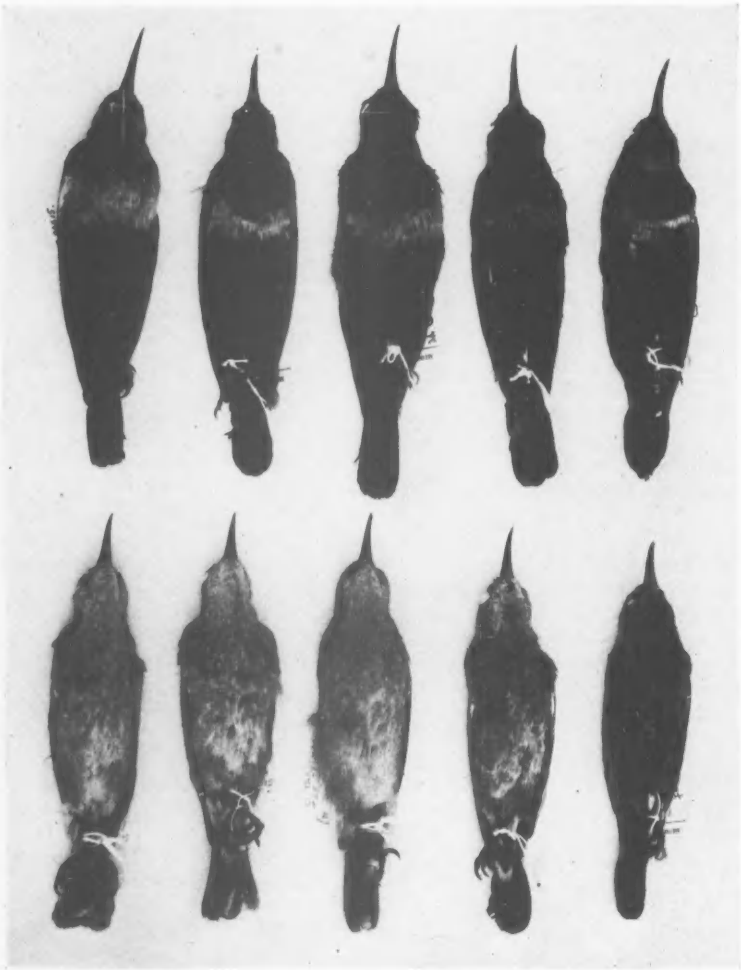

Fig. 1. The races of *Cinnyris habessinicus*. From left to right (males above, females below): *turkanae, habessinicus, alter, hellmayri, and kinneari*. Photograph by J. S. Karmali.

THE RACES OF CINNYRIS HABESSINICUS

Cinnyris habessinicus is readily divisible into five well-marked races, three on the African mainland and two in Arabia, distinguishable by plumage and structural characters in the adults (fig. 1). Immature birds have not been specially mentioned in the descriptions of individual subspecies, but variation in their plumage characters follows that of the adult female, being paler in the southern races and darker in the more north-

ern. All measurements quoted are in millimeters, taken to the nearest half millimeter. Wing measurements were taken from the flattened wing.

Cinnyris habessinicus habessinicus (Hemprich and Ehrenberg)

Nectarinia (*Cinnyris*) *habessinicus* Hemprich and Ehrenberg, Symb. Phys., 1828:fol.a, pl. iv; Eilet, Eritrea.

Characters.—The smallest race (table 1); adult male characterized by relatively narrow, deep red breast band, 7.5–11 wide (20 measured), fringed below with a line of metallic bluish feathers. Adult female intermediate in color between paler race *turkanae* and two darker Arabian races, *hellmayri* and *kinneari*; and lacks ill-defined greenish-orange breast band frequently found in adult female *alter*.

Distribution.—Eritrea and adjoining districts of Ethiopia (Abyssinia) and the northeastern Sudan north to the Egyptian border. Intergrades with *alter* in the Harar region of Ethiopia and probably in French Somaliland.

Localities from which specimens examined.—ERITREA. Maritime plains near Massawa; Eilet Plain (eastern Eritrea); near Adi Ugei (in Eritrean highlands). SUDAN. Port Sudan; Gebel Elba on the Egyptian border. ETHIOPIA. Dire Daua, Harar district; these specimens are intergrades between *habessinicus* and *alter*.

Meinertzhagen (1930:171) recorded two specimens of *C. habessinicus* collected at Gebel Elba, on the northeastern border of the Sudan, that were identified as the race *hellmayri*, known otherwise only from southwestern Arabia. These two specimens have not been available for the present study, but another specimen, an adult male, from Gebel Elba agrees perfectly in both plumage and size with a series of the nominate race from Eritrea. Measurements of this specimen are wing 65, exposed culmen 19, tail 45, tarsus 15.5. In addition, Mr. J. D. Macdonald informs me that two specimens of *habessinicus* from Gebel Elba in the British Museum (Natural History) collections also are referable to the nominate race. On this evidence it is obvious that the two specimens from Gebel Elba referred to by Meinertzhagen were wrongly identified and that the race occuring there is *habessinicus*.

Cinnyris habessinicus turkanae van Someren

Cinnyris habessinicus turkanae van Someren, Bull. Brit. Ornith. Club, 60, 1920:94; Kohua River, Lake Rudolph, Turkana, Kenya Colony.

Characters.—Averages slightly larger than *habessinicus* in length of wing, tail, and tarsus, and has a longer bill. Adult male differs from all other races in having very broad and paler red breast band, 14–19 wide (23 measured), with only slightest indication of metallic feathering below, or, more generally, no fringe of metallic feathers at all. Female paler below than in any other race.

Distribution.—The Northern Province and Turkana districts of Kenya Colony, northeastern Uganda, southeastern Sudan, southern Ethiopia (Abyssinia), and the southern half of Italian Somalia north to latitude 6°N.

Localities from which specimens examined.—KENYA COLONY. Northern Frontier District: Malka Murri on the Daua River; Mandera. Turkana: Lodwar district; Lokitaung; Turkwell River; Kohua River; Ferguson's Gulf, Lake Rudolph. UGANDA. Karamoja-Turkana border, west of Lodwar. SUDAN. The Ilemi Triangle (southeastern Sudan). ETHIOPIA. Scenan, Arussi plateau (southern Ethiopia). ITALIAN SOMALIA. Dolo, Juba River; Belet Uen and 30 miles north of Belet Uen.

In his original description, van Someren (1920:94) mentioned, in addition to the character of the wider and paler red breast band, that *turkanae* differs from *habessinicus* in being more golden-green above with the rump also golden-green, not bluish. While most specimens of *turkanae* fit this description, there also are Eritrean specimens of *habessinicus* which are equally golden-tinged above, so that this character cannot be used in separating the two races.

Table 1

Measurements of Adult *Cinnyris habessinicus* in Millimeters

Race	Dimension	Sex	Number of specimens	Range	Mean	Standard deviation
C. h. habessinicus	Wing	♂♂	20	64 –68	66.22	1.03
		♀♀	8	58.5–60	59.00	0.45
	Exposed culmen	♂♂	20	18.5–20.5	19.50	0.67
		♀♀	8	18 –19	18.37	0.44
	Tail	♂♂	20	44–48	46.40	1.18
		♀♀	8	40–41	40.62	0.51
	Tarsus	♂♂	20	15.5–16	15.85	0.74
		♀♀	8	15.5	15.50	.....
C. h. turkanae	Wing	♂♂	23	66–69	67.10	0.92
		♀♀	11	58–60	58.81	0.87
	Exposed culmen	♂♂	23	21–23	21.93	0.52
		♀♀	11	19.5–21.5	20.45	0.61
	Tail	♂♂	23	46–51	48.34	1.55
		♀♀	11	39–41	40.91	0.53
	Tarsus	♂♂	23	16–17	16.52	0.43
		♀♀	11	16–16.5	16.13	0.23
C. h. alter	Wing	♂♂	28	69–72	70.37	1.01
		♀♀	12	61–64	62.58	0.90
	Exposed culmen	♂♂	28	22.5–25	23.46	0.80
		♀♀	12	20 –22	21.00	0.67
	Tail	♂♂	28	48–56	51.89	2.01
		♀♀	12	43–49	45.33	2.34
	Tarsus	♂♂	28	17–18	17.71	0.24
		♀♀	12	17–17.5	17.20	0.26
C. h. hellmayri	Wing	♂♂	7	70–75	72.00	1.82
		♀♀	5	62–66	64.40	1.26
	Exposed culmen	♂♂	7	21.5–23	22.35	0.62
		♀♀	5	20 –21.5	20.90	0.54
	Tail	♂♂	7	51–56	54.42	1.76
		♀♀	5	44–49	46.40	2.51
	Tarsus	♂♂	7	16.5–17	16.85	0.24
		♀♀	5	16	16.00	.....
C. h. kinneari	Wing	♂♂	5	70–75	72.00	0.59
		♀♀	2	64–65	.....	.....
	Exposed culmen	♂♂	5	18.5–20	19.20	0.57
		♀♀	2	17.5–19	.....	.....
	Tail	♂♂	5	51–57	54.60	2.30
		♀♀	2	49–50	.....	.....
	Tarsus	♂♂	5	16 –16.5	16.40	0.22
		♀♀	2	15.5–16	.....	.....

Cinnyris habessinicus alter Neumann

Cinnyris habessinicus alter Neumann, Ornith. Monatsb., 14, 1906:7; North Somaliland to Harar.

Type locality.—In his original description, Neumann did not designate an exact type locality. Since specimens from the Harar district are somewhat intermediate between *alter* and the nominate race, it is desirable that an exact type locality be designated. As Neumann mentions North Somaliland within the range of this race, I propose to fix the type locality of *Cinnyris habessinicus alter* Neumann to Erigavo (latitude 10° 40′ N, longitude 47° 25′ E), 6500 feet, northeastern British Somaliland.

Characters.—Resembles ***habessinicus*** but larger, with a much longer bill. In adult male red breast band deep in color, 9–13 wide (28 measured), with well-marked fringe of metallic bluish or violet-green feathers. Adult female darker above and below than either ***habessinicus*** or ***turkanae***; many specimens tend to have an ill-defined band of greenish-orange across the breast.

Distribution.—British Somaliland and adjoining areas of Ethiopia, and northern Italian Somalia. Intergrades with ***habessinicus*** in the Harar region of northern Ethiopia, and probably in French Somaliland.

Localities from which specimens examined.—BRITISH SOMALILAND. Sheikh; Hudin; Erigavo; Hargeisa; Berbera; Garadak; El Afwein; the escarpment north of Erigavo; Medishe. ETHIOPIA. Hargeisa-Harar road. NORTHERN ITALIAN SOMALIA. Gardo.

Specimens collected near Berbera and farther east on the maritime plain are typical ***alter***, showing no approach to the nominate race. A most interesting aberrant adult male of ***alter*** was collected near Hudin, southeastern British Somaliland, on March 6, 1954. In this specimen the bluish-green feathering below the red breast band extends to cover the lower breast, flanks, and under tail-coverts, and even the black abdomen is slightly glossed with green. There can be no doubt that this is merely an individual variant. Several other specimens collected in the same locality are typical examples of ***alter***.

Cinnyris habessinicus hellmayri Neumann

Cinnyris habessinicus hellmayri Neumann, Ornith. Monatsb., 12, 1904:29; mountains north of Lehej.

Characters.—Similar in size to ***alter*** but bill shorter. Adult male differs conspicuously from the three African mainland races in having red breast band obscured and greatly darkened throughout by subterminal bars of metallic greenish-blue; also, metallic crown more bluish, less violet, than in other races. Adult female resembles female ***alter*** but plumage darker, although not blackish-brown as in female ***kinneari***.

Distribution.—Southwestern Arabia from Yemen and the Aden Protectorates, including the Hadhramaut, north to the Saudi Arabian border.

Localities from which specimens examined.—ADEN PROTECTORATE. Lodar. YEMEN. Taiz.

The pectoral tufts of adult male ***hellmayri*** are reputed to be paler than in other races, but I do not find that this is constantly the case. While two specimens have paler yellow tufts than is usual, other examples from the same locality have pectoral tufts as bright as in any specimen of the other races.

Cinnyris habessinicus kinneari Bates

Cinnyris habessinicus kinneari Bates, Bull. Brit. Ornith. Club. 55, 1935:120–121; near Sail (east of Mecca).

Characters.—Size as in ***hellmayri*** but bill constantly shorter. Adult male differs from ***hellmayri*** in having only lower two-thirds of breast band obscured and darkened by bluish subterminal bars, thereby isolating a narrow red collar immediately below the metallic green throat.

Adult female very distinct from females of any other race, being much darker in color, almost blackish in some examples, and feathers of the throat and abdomen have narrow pale fringes producing scaly appearance. These pale fringes are present in the females of the other races but are not conspicuous as they do not contrast with the basic plumage color (see color plate).

Distribution.—Western Saudi Arabia, north to the Hejaz, south to the Tihama, and into the foothills of Asir.

Localities from which specimens examined.—SAUDI ARABIA. Sail Kebir; Madriga near Jidda; Hadda near Jidda; Birka, Hejaz.

It is remarkable that only Meinertzhagen (1954:592) has called attention to the difference in plumage between adult males of ***kinneari*** and ***hellmayri***. Apart from the difference in the red breast band, males of the two races may be distinguished on bill length. It has been suggested incorrectly that the blackish-brown females of ***kinneari*** are juvenal males which have been wrongly sexed and that the females of this race are

not distinguishable from females of *hellmayri*. It is undeniable that the juvenal plumage of this race is very dark indeed—almost completely black below—but no one having experience with sunbirds could mistake an adult female for a juvenile. To confirm that the two female specimens in my possession were adults, I relaxed the skins and found, as I had expected, that both skulls were completely ossified.

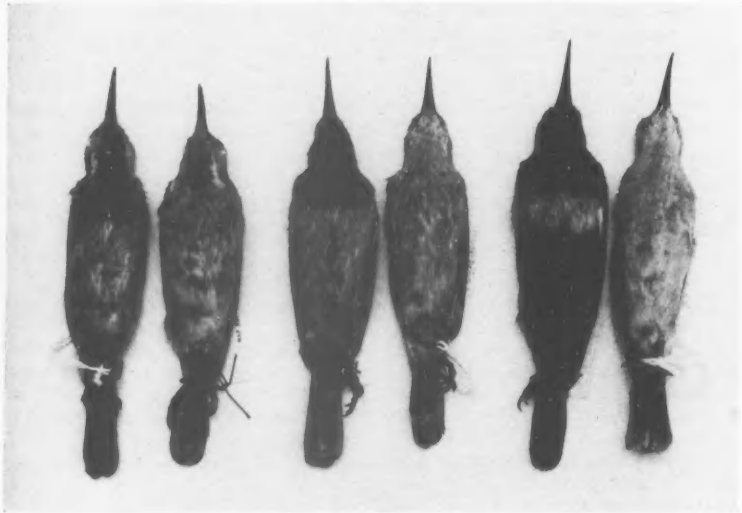

Fig. 2. The plumages of *Cinnyris habessinicus*. From left to right: juvenal male, juvenal female; immature male, immature female; adult male, adult female. Specimens are *C. h. turkanae*. Photograph by J. S. Karmali.

PLUMAGES

All races of *Cinnyris habessinicus* possess three distinct plumages, juvenal, immature (intermediate) and adult (fig. 2).

The juvenal plumage of both sexes resembles that of the adult female but the body feathers are juvenal in texture. In color and markings it differs from that of the adult female in having the chin whitish, the white merging on the throat into a black patch which extends on to the breast and which is bordered on each side by a line of whitish feathers. The juvenal male usually has a blacker throat than the juvenal female, in which the black throat patch is often obscured by whitish tips to some of the feathers. *Cinnyris habessinicus* in juvenal dress may be mistaken for juveniles of the closely allied *Cinnyris mariquensis*, especially as the two species are often found in the same haunts. Juvenal *C. mariquensis* differs from *C. habessinicus* in having the black throat patch continue on to the breast and flanks as a series of large, blackish, droplike spots; it is also usually strongly washed with yellow on the underparts.

Mackworth-Praed and Grant (1945) state that the immature plumage is acquired by a complete molt which includes wings and tail. I do not find that this is the case in most instances. In a series of 22 specimens examined I found that molt into immature plumage involved the body feathers only, with occasionally an odd pair of rectrices and

some wing feathers being renewed. However, in one immature specimen, a male of *alter* from Medishe, Erigavo district, British Somaliland, the molt had been complete, including wings and tail. In this specimen the newly molted wing feathers are as in the adult female, but the rectrices are darker, although not so black as in the adult male. The immature male plumage closely resembles that of the adult female above, but below it has the chin, throat, and upper breast metallic green, bordered below by a few red feathers. The belly is as in the adult female, but usually there are a few black feathers present. The immature female closely resembles the adult plumage, and some immatures (age confirmed by examination of skull ossification) cannot be distinguished from adult females, but as a rule immatures have darker centers to the breast feathers, giving a mottled effect.

The adult plumage of both sexes is acquired by a complete molt, involving wings and tail. When this molt is completed the first-adult dress is not distinguishable from the plumage of older birds. *C. habessinicus* has no eclipse plumage, the adult male molting from metallic dress to metallic dress. The following adult males in molt have been examined:

C. h. habessinicus. Eritrea: Adi Ugui, October. Sudan: Port Sudan, December (molt almost complete).
C. h. turkanae. Kenya Colony: Turkana, September.
C. h. alter. British Somaliland: Berbera, December (molt almost complete).
C. h. hellmayri. Yemen: Taiz, December. Aden Protectorate: Lodar, December.
C. h. kinneari. Saudi Arabia: Madriga near Jidda, January (molt almost complete).

NATURAL HISTORY

Habitat.—Rocky or sandy broken country with a coverage of acacia trees is the main habitat of *Cinnyris habessinicus*. It especially favors dry river beds (wadis) with flowering *Acacia* and *Ziziphus* trees and bushes, and it is also much attracted to the flowers and fruits of the bushy *Salvadora persica*.

In Eritrea the nominate race is common in acacia bush country from sea level up to an altitude of 4000 feet on both the eastern and western sides of the Eritrean plateau (Mr. K. D. Smith, *in litt.*). Above that altitude it is absent from the plateau itself but occurs sparingly up to 6000 feet in wooded or scrub-covered mountain valleys in the northern, western, and southern parts of the country.

The race *alter* has a greater altitudinal range than *habessinicus*. It is equally at home among the thorn trees in the sweltering heat of the maritime plain and in the high-level juniper forest region of northeastern British Somaliland, where in the early mornings the ground and vegetation are white with hoar frost. In the Erigavo juniper forest at 7000 feet *alter* was especially abundant, feeding in numbers among the blossoms of a bushy, purple-flowered *Salvia*. For two or three hours after dawn only those salvia bushes in direct sunlight were visited, those in the shade being completely neglected. It seemed strange to see this sunbird, which one usually associates with arid, rocky, thorn-bush country, so completely at home in forested surroundings, especially when dense moisture-laden clouds enveloped the landscape and visibility was reduced to a few yards. The birds spent most of their time seeking insects and spiders among the branches of the juniper trees and the hanging clumps of *Usnea* with which the branches were festooned. Their appearance at such times was strongly reminiscent of *Cinnyris mediocris* in the mountain forests of Kenya and Tanganyika. At lower altitudes in its range *alter* does not differ in its habits from the other races, but perhaps it shows a greater preference for the flowers of *Calotropis procera*.

The race *turkanae*, unlike the other two African races, does not appear to occur in localities above 4000 feet and is most frequent in areas below 2000 feet. In the Northern

Frontier and Turkana districts of Kenya Colony it was encountered most commonly in rocky, semi-desert country with mixed *Acacia, Ipomoea,* and *Commiphora* scrub (fig. 3). In Turkana it also occurs in *Acacia* trees and thickets of *Salvadora persica* scrub bordering dry, sandy riverbeds. Near Lodwar, Turkana, I found great concentrations of sunbirds attracted to fruiting *Salvadora* bushes, and the bushes seemed alive with these active, brilliantly colored birds. Also, the long-tailed, golden-breasted sunbird *Hedydipna platura* was abundant, together with dozens of *Nectarinia pulchella* and

Fig. 3. Typical habitat of *Cinnyris habessinicus turkanae* in northern Kenya Colony, showing rocky, semi-desert country with mixed *Acacia, Ipomoea* and *Commiphora* scrub. Photograph by Desert Locust Control and Survey Organization.

Cinnyris venustus, the odd *Cinnyris mariquensis,* and a host of *Cinnyris habessinicus turkanae.* It was certainly an experience of note to stand in the center of a clump of *Salvadora* bushes while twenty or thirty sunbirds fed all around, quite unconcerned by the intrusion of a human into their domain.

In Arabia both *hellmayri* and *kinneari* inhabit rocky and sandy country mainly below 4000 feet, favoring wadis with a light growth of thorny *Acacia* and *Ziziphus* trees and bushes such as *Salvadora* and *Calotropis* (fig. 4). *C. h. kinneari* is reputed to have greater preference than *hellmayri* for the few cultivated areas which exist in its range.

Food.—The fruits of the bush *Salvadora persica,* which resemble tiny bunches of grapes, form an important item in the diet of all races of *Cinnyris habessinicus,* and it has been my experience that when feeding on these fruits the birds take comparatively little animal food. At other times, spiders, various small insects and insect larvae, and nectar complete the diet. Two specimens of the nominate race collected at Port Sudan had their stomachs crammed with small spiders and some insect fragments, including Diptera and Coleoptera. An examination of the stomach contents of *turkanae* showed that spiders also form the bulk of the animal food taken, spider fragments being present

in nearly every specimen examined. Also present, in their order of abundance, were remains of the following insects: Diptera; minute Coleoptera; Lepidoptera larvae; minute Hemiptera, and, once, Hymenoptera (possibly small chalcids). *C. h. turkanae* obtains its spider and insect food among blossoms and, sometimes, the foliage of various trees and shrubs. It also visits the fruits of fig trees when these are ripe. Flowers especially favored are those of various species of *Acacia,* the spiny *Ziziphus spina-christi, Salvadora,* and a red- and yellow-flowering *Loranthus* parasitic on acacia trees. Spiders

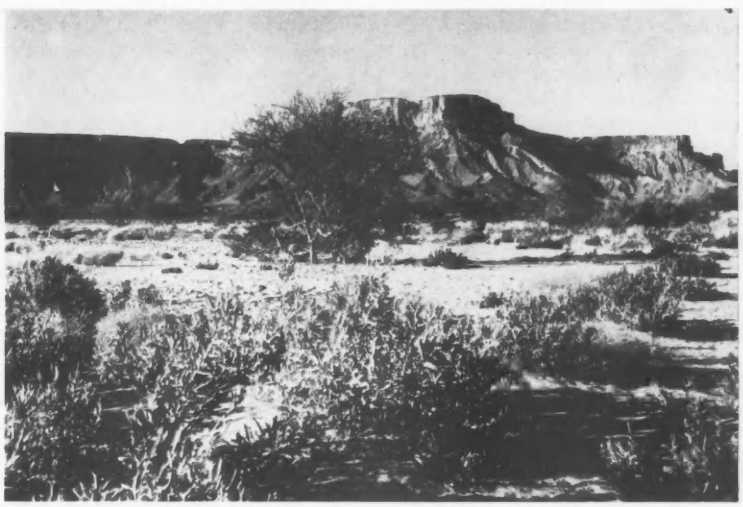

Fig. 4. Wadi near Bir Asakir, Hadhramaut, the haunt of *Cinnyris habessinicus hellmayri.* Photograph by Desert Locust Control and Survey Organization.

also form the main item of diet in the race *alter,* but specimens collected in the juniper forest north of Erigavo had taken more Diptera and minute Coleoptera than had birds collected at lower altitudes. One bird from this locality had its throat, crop, and stomach crammed with a small species of termite in the flying stage. The feeding habits of *hellmayri* and *kinneari* do not appear to differ from those of other races. The former is said to be much attracted to the inflorescence of date palms.

Field appearance.—In the field *Cinnyris habessinicus* appears as a medium-sized golden-green sunbird with a black belly and a red breast band, which is more or less conspicuous according to the race observed. The female is readily identifiable by its uniformly colored pale or dark gray underparts.

When one is used to the appearance of *turkanae* and *alter* in the field, the impression on first seeing the race *habessinicus* alive is its small size. It is possible to confuse the male of the nominate race with the male of *Cinnyris mariquensis osiris* unless a good view of the former's red breast band is obtained, especially as the yellow pectoral tufts, which also distinguish *habessinicus* from *mariquensis,* are not usually conspicuous unless the bird is displaying or engaged in chasing off a rival. There is no risk of confusing the females of the two species, as *C. habessinicus* has uniformly colored underparts while *C. mariquensis* has heavy dark mottling on the throat, breast, and flanks.

The race *turkanae* may be identified in the field by its very conspicuous, broad red breast band. There is no danger of mistaking the male for *Cinnyris mariquensis* as is possible with the nominate race. *C. h. alter* appears noticeably larger than the other two African races. Under certain conditions the golden sheen of the male's upperparts is very striking in the horizontal light of early morning.

The only living examples of *hellmayri* that I have seen were near Aden, when I was struck by the dark appearance of their underparts; the obscured red breast band was not conspicuous. The only other sunbird at all similar which occurs within the range of *hellmayri* is *Cinnyris osea,* a much smaller bird without a red breast band and with orange-red and yellow pectoral tufts. In the case of *kinneari,* judging from the appearance of study skins and my experience with the other races, it is probable that the narrow red breast collar is more noticeable in the field than the wider but much darker breast band of *hellmayri.* The very dark female of *kinneari* should also be recognizable alive.

Vocalizations.—There would appear to be little or no geographical variation in the call notes and song of *Cinnyris habessinicus,* but I gained the impression that the call notes of the male of *alter* were louder and clearer than those of males of other races. The calls and song of *kinneari* have not been recorded.

The usual call in all races is either a rather sharp *tsp, tsp, tsp,* each note uttered separately, or a less harsh *tss tss tss tss,* in which the notes are more or less run together. The latter call is very like that of another sunbird, *Hedydipna platura.* The male also has a loud, single call note, usually heard just before the bird takes wing. The adult male has an attractive warbling song which often is delivered from the topmost branch of a thorn tree. It starts with a series of quickly uttered notes, *ch ch ch ch ch,* and is followed by two or three rather long, drawn-out single notes, *chee – chee – chee,* with an appreciable break between each; this is repeated over and over again. The female has a low subsong, a soft warble, usually delivered from among the foliage of a tree or shrub.

Display.—The display of *Cinnyris habessinicus* commences with the male drawing himself into a very upright attitude with the plumage compressed; this is followed by a quick shuffle along the branch toward the female, at which time he sways his body quickly from side to side and suddenly expands his feathers and fans out his pectoral tufts. In every display that I have watched, the female appears to take no notice whatsoever of the male and continues to feed until his movements bring him too close, when she flies off, with the male in quick pursuit. I have never seen the female give any encouragement to her suitor. At times a second male will alight in the same tree in which a displaying male is present, but he is soon chased off in no uncertain fashion. A single male will sometimes stop in the middle of a display, fly straight up into the air for a few feet as if fly-catching, and then return to his original perch and burst into song. This "fly-catching" interruption was often observed in northern Kenya, but it was not noted in the case of *alter.* Except when displaying or about to display, the male appears to be fairly tolerant of the presence of potential rivals and I have several times watched four or five males feeding together in the same flowering tree.

Breeding seasons.—On the maritime plain in Eritrea the nesting of *habessinicus* coincides with the winter rainfall in December and February, as in most species of birds on the coast (K. D. Smith, *in litt.*). On February 2, 1951, Mr. Smith encountered a single fledgling being fed by an adult. At higher altitudes the breeding season may be later, or more prolonged, as Mr. Smith flushed a female from a nest containing a clutch of one on June 10, 1951. He wrote to me as follows: "For some reason the general breeding season on these slopes [the plateau escarpment some twenty miles inland from the mari-

time plain] seems to take place in Spring—April to June—whereas it commences on the maritime plain as early as December, when the first rains fall. Why exactly I do not know; both areas have their main rainfall in winter and there seems to be no logical reason why breeding should be delayed on the slopes. June seems a late date; the trees then were almost leafless and conditions apparently [were] unfavorable for raising a brood." Adults in full breeding condition were collected by Mr. Smith near Massawa, on the maritime plain, on December 24 and 30 and January 1, and on the Eilet Plain, 800 feet, in eastern Eritrea, on March 5 and 7.

In the Northern Frontier District of Kenya Colony the nesting season of *turkanae* is rather lengthy. Basing my conclusions on nests found, the presence of recently fledged juveniles, and the condition of gonads in adult specimens collected, I estimate that breeding starts during April, perhaps exceptionally in March, and continues until late June or early July, with a peak period during May. This breeding season coincides with the long rains. An adult male with gonads in full breeding condition was collected at Malka Murri on the Daua River as late as June 29. In southern Italian Somalia adults collected during February had gonads commencing to enlarge, so breeding probably takes place there during the same period as in the Northern Frontier District of Kenya. The same would apply to southeastern Ethiopia. In Turkana and southeastern Sudan, and probably also in southwestern Ethiopia, the breeding season of *turkanae* is shorter, extending from early May to early July. A few adults collected in Turkana during the first week of May were not quite in full breeding condition. Nests containing the full clutch of one egg were found in Turkana on May 6 and 10.

The breeding season of *alter* varies according to altitude. Birds in the highest zones commence breeding during April and May, those occurring between 4000 and 5000 feet start nesting during February and March, and those at lower altitudes down to sea level begin nesting in January, and perhaps even in December. An adult male collected by Mr. George Popov at sea level near Berbera on December 29 was in full breeding condition. The duration of the breeding season varies between three and four months, judging from gonad development in specimens collected.

The race *hellmayri* breeds from late March until May, on the evidence of immature and juvenal birds, and *kinneari* also nests at this time. Meinertzhagen (1954) recorded a nest of the latter under construction at Birka in early April, and the gonad development of an adult male collected at Sail on March 3 indicated that breeding would have occurred within four to six weeks. Bates (1930) stated that "in February these sunbirds seemed about to begin breeding."

Nesting sites and nests.—The nesting site chosen by *Cinnyris habessinicus* is in a thorny tree or shrub, the nest being attached to and suspended from the middle of a sloping branch. Often it is placed high up in the center of a tree, surrounded by other branches. The site may be from four or five to over twenty feet above the ground, but most nests are between ten and twelve feet up. In the more than 30 nests that I have examined the entrance faced toward the center of the tree or bush in which it was situated. Nests may be placed in exposed positions or hidden among surrounding foliage.

I have examined the nests of all races of *Cinnyris habessinicus* with the exception of *kinneari*, and I find that nest construction and materials used do not vary geographically. The nest is an oval or pear-shaped structure, measuring about 4½ inches long by 3 inches maximum width, attached to a sloping branch by means of a bulky support at the top of the nest dome (fig. 5). The reinforced supporting structure is continued along the branch to above the entrance, which is located at one side near the top and is protected by a well-marked porch. The round entrance faces in toward the middle of the

tree immediately below the support structure. Externally the nest is composed mainly of a curious silvery-gray plant fiber, with some strands of withered, soft grass, a few dead leaves, and some old insect cocoons, the whole woven together with spider web and insect silk. The external plant fiber imparts a unique silvery sheen to the nest, which at a distance has a marked resemblance to the nest of some wasps. The inside is very thickly lined with either orange-tinted plant wool from the seeds of *Ipomoea* or, sometimes, the paler colored seed down of *Calotropis*. Meinertzhagen (1954), in his description of the nest of *kinneari*, stated that some tiny feathers were present in the lining in addition to plant wool.

Fig. 5. Nest and egg of *Cinnyris habessinicus turkanae*. Photograph by J. S. Karmali.

Fig. 6. Nest of *Cinnyris mariquensis suahelicus*. Photograph by J. S. Karmali.

In general shape the nest of this sunbird is very like that of *Cinnyris mariquensis*, suggesting that the two species are allied; but the materials used in construction are very different. The nest of *Cinnyris mariquensis* (fig. 6) has the outer covering built up of flat pieces of greenish and gray lichen bound with spiders' web. Inside it is thickly lined with feathers, generally those of doves or francolins, which protrude from and conceal the entrance.

The nest of *Cinnyris habessinicus* is built entirely by the female, as are all sunbirds' nests that I have had under observation, but the male often accompanies the female to and from the nest during building operations. Both birds assist in the feeding of the single nestling.

Meinertzhagen (1954) made the very surprising statement concerning a nest of *kinneari* that "the male was more responsible for nest-building than the female." This, I feel, may have been a mistaken observation, due to the fact that the male is extremely noticeable during the female's nest-building operations, often accompanying her right up to the nest.

It is a constant source of amazement to me that even nowadays many of the accounts

of sunbirds' nesting habits still dismiss the nest with a few words such as: "pendulous nest of usual sunbird type." Actually, there is no such thing as the "usual type of sunbird's nest." Every species that I have studied has its own particular type of nest, with characters of shape, construction, and, generally, materials peculiar to the species. As an example, nests of *Anthreptes orientalis* have a characteristic loose weave and are always ornamented on the outside with at least a few old praying-mantis egg capsules. Species that are closely allied generally build nests that have much in common but differ in detail. I am convinced that a study of the nests of various sunbirds would do much toward our achieving a knowledge of the true relationships between various species of the family. To mention an example, it is now generally agreed that *Nectarinia nectarinioides* and *Nectarinia erlangeri* are conspecific and that the latter has no very close relationship with *Nectarinia erythroceria,* to which it bears a superficial resemblance. This is confirmed by the fact that the nests of *nectarinioides* and *erlangeri* are indistinguishable and quite unlike the nest of *erythroceria*. In turn, the nests of *nectarinioides* and *erlangeri* somewhat resemble those of the *Nectarinia pulchella-melanogastra* group, indicating a relationship, although not conspecific, which also is confirmed by the plumage characters of these birds.

Description of eggs.—So far as we know the complete clutch of *Cinnyris habessinicus* consists of one egg only. The eggs of the two Arabian races are at present unknown.

Altogether I have examined six occupied nests of *turkanae,* two of which contained one egg and four in which there was a single nestling. The eggs are slightly pointed ovals with a little gloss. The ground color is white; one has a zone of pale mauve-gray with superimposed blackish markings around the larger end; the second lacks most of the mauve-gray cap and is more sparingly marked with black. Measurements of the two eggs examined are 19×13.5 and 19.5×14. The single occupied nest of *alter* I have found contained a single egg on the point of hatching. It was pointed oval in shape with a slight gloss, white in ground color, and with several large blotches of pale grayish-brown and a few overlying scrawls of black at the large end. It measured 19.5×15. Unfortunately Mr. K. D. Smith did not collect the single egg of *habessinicus* which he found. This he describes as being white with brown smudges.

ACKNOWLEDGMENTS

It is a pleasure to place on record my appreciation of the kind cooperation I have received from many friends during the preparation of this paper. To Colonel R. Meinertzhagen I am especially indebted for material of the two Arabian races of *habessinicus* and data on their distributions, without which it would have been impossible to write this paper. Mr. Kenneth D. Smith and Mr. George Popov of Desert Locust Control and Survey Organization collected many valuable specimens and supplied field notes; my friend Mr. John S. Karmali photographed specimens and nests—difficult subjects—with his usual brilliance; Mons. J. Delacour kindly supplied me with a copy of his paper on the family Nectariniidae and has given me his views on certain aspects of sunbird classification; Mr. Bernard Verdcourt of the East African Herbarium provided identifications of botanical material with unfailing courtesy; Dr. A. L. Rand of the Chicago Natural History Museum kindly sent me on loan an important specimen collected on Gebel Elba in the northeastern Sudan; Mr. J. D. Macdonald of the British Museum (Natural History) kindly supplied me with details of certain specimens under his care; and Mr. Derek Goodwin, also of the British Museum, has taken much trouble in supplying copies of original descriptions not available to me in Africa. Lastly my thanks go to the Desert Locust Control and Survey Organization for their kindness in presenting me with two photographs illustrating habitat.

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ANNUAL CYCLE IN A POPULATION OF CALIFORNIA QUAIL

By RICHARD E. GENELLY

This report presents an analysis of the life cycle of the California Quail (*Lophortyx californica*) based primarily on three years of trapping and observation on San Pablo Ridge, Contra Costa County, California, between 1950 and 1953. Additional observations of penned quail were made on the Davis campus of the University of California during the spring and summer of 1954. The primary purpose of my study has been to determine the extent and causes of changes in the density of California Quail on a relatively undisturbed area. Much is known of the responses of quail populations, in general, to changes in composition and distribution of vegetation, to the availability of water, and to extreme weather conditions. Yet to be explained, however, are population fluctuations of considerable magnitude, such as those noted by Emlen (1940), that cannot be correlated with obvious environmental changes. The present contribution on the annual cycle may be considered only to lay the foundation in this long-term investigation. Yearly shifts in the timing of the events of the reproductive cycle, in particular, are promising in that they suggest the importance of weather conditions to reproductive success. The fragmentary nature of my observations, while limiting their value for yearly comparisons, suggests the normal sequence and timing of behavioral and physiological events in the quail in this region.

The writer wishes to express his gratitude to Dr. A. Starker Leopold for his guidance and encouragement and for his active participation in field work. Wallace C. Macgregor assisted materially in the trapping program, while K. L. Dixon and Ward Russell generously took part in the censuses. Gene Smith, fire lookout for the City of Berkeley, provided detailed weather observations. G. V. Morejohn and J. DeVaul assisted in the construction of several of the figures. I am especially grateful to Dr. Richard D. Taber for his enthusiastic assistance in several aspects of the study. Alden H. Miller, Lewis W. Tayler, and A. S. Leopold read the manuscript and offered many useful suggestions. The facilities of the Department of Zoology of the University of California, Davis, were very helpful in the terminal phases of the work.

THE STUDY AREA

The principal area for population study (area A) was 100 acres in size, centering on the eastern slope of San Pablo Ridge, Contra Costa County, one-half mile north of Inspiration Point and an equal distance to the west of San Pablo Reservoir (see fig. 1). A contiguous area (area B) of irregular shape, lying on the west-facing slope of the ridge in Tilden Regional Park, was where most observations of behavior were made.

Area A is a small fraction of the watershed lands owned and managed by the East Bay Municipal Utility District in the vicinity. Acquisition of the land by the utility district has resulted in the elimination of most human disturbance (no public access is permitted), but grazing by cattle continues. At the present time the grazing lease limits the level of stocking to one animal per ten acres, for an eight month season, from November to June. Grazing, in other words, is moderate.

Area B is transected by a one-mile strip of winding dirt road, the "fireroad" which extends from Inspiration Point in a northerly direction along the eastern boundary of Tilden Park. This land was set aside for recreational use in 1934 and has not been used by livestock for 20 years. Use of the fireroad is restricted to emergency vehicles and to foot travel.

The topography of both areas is moderately rugged. Area A is broken up by two parallel ridges and their associated draws that extend from the main ridge down in a southeasterly direction to the San Pablo Reservoir. The area is thus composed of a series of north- and south-facing slopes. The northern end of area B is essentially similar in topography to area A. The southern two-thirds, however, is principally composed of the tops of the rounded knolls and steep slopes of San Pablo Ridge.

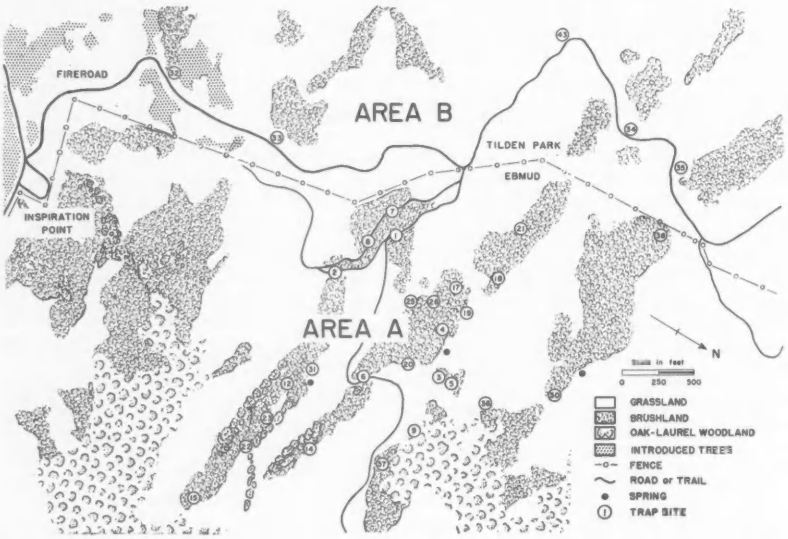


Fig. 1. The study area. The fine line separating Area A from Area B marks the crest of San Pablo Ridge.

The climate of the study area is mild. While rain falls frequently in the winter and spring months, it is practically absent in the summer and early fall. Frosts occur every year but are infrequent, whereas snow in measurable amounts may not fall for a period of several years. Ocean fogs may occur in any month of the year in the San Francisco Bay Region, and they frequently spill over San Pablo Ridge in the summer months.

The vegetation of both areas reflects the topography and land-use of each. The north-facing slopes of both areas are dominated by coyote brush (*Baccharis pilularis*) and poison oak (*Rhus diversiloba*). These species are replaced by live oak (*Quercus agrifolia*) and California laurel (*Umbellularia californica*) in the deeper canyons, well below the crest of the main ridge. A small plantation of Monterey pine (*Pinus radiata*) at the southern edge of area B is of considerable importance to the quail in that area as roosting and escape cover. Both areas are also characterized by extensive grassy slopes. These differ in density as a result of the differences in land-use. Due to the grazing of livestock, area A contains a higher percentage of forbs such as burclover (*Medicago hispida*) and filaree (*Erodium* sp.). The principal grasses are annuals dominated by wild oat (*Avena fatua*). Area B supports a much more rank growth of grasses and forbs in the growing season than does area A.

METHODS

Trapping.—The traps used went through evolutionary changes to adapt to several requirements. The material used was a galvanized poultry netting of one-inch mesh. The size of this mesh made it impossible to capture quail younger than about three to four weeks. In the first traps, a section of the netting was folded into the shape of an elongate box, 10 to 12 feet long, the edges being secured to the ground with large spikes. A small entrance funnel, made of the same material, was placed under the edge of the trap at ground level. Brush cuttings were thrown over the top to screen the captured birds from the vision of passing accipitrine hawks. A standard quail trap (Stoddard, 1931), made of ½-inch hardware cloth folded over a wooden frame and painted a dark green, seemed to be avoided by the quail. Subsequent traps were made smaller than the original model so that they could be folded up quickly and carried in an automobile. The dangle wires that were later used in the entry funnels proved necessary to forestall the exit of the few quail that became familiar with the funnel system. During the breeding season the trap could be converted to a cock-and-hen trap by placing a small cubicle of hardware cloth containing a live female within the larger trap.

Due to limitations of time and equipment, traps could not be placed at random. Since it seemed important to capture and mark as high a percentage of the population as possible, traps were placed at sites that offered the most promise of catching birds. Trapping was necessarily irregular during the three-year period, but an effort was made to devote at least a few days in each month to observation and trapping.

The most successful bait mixture contained a high proportion of small seeds, such as those of rape and millet. The quail seemed to take these small seeds at any season of the year, regardless of the natural food supply available to them or of previous familiarity with the bait. Mixtures containing larger seeds, such as wheat, barley and cracked corn were usually rejected entirely or the smaller seeds were selected while the larger seeds were left lying on the ground. Sumner (1935:190) noted that captive quail at first had difficulty in swallowing large unfamiliar barley seeds. Over a period of several days, however, the quail learned to cope with them successfully.

Marking.—Buss (1946:132) concluded from an extensive banding study of pheasants in Wisconsin, that "... good aluminum leg bands are not lost, but weak or thin aluminum bands may be lost in considerable numbers." Studies of various marking devices on penned pheasants at the Yountville State Game Farm (Ken Doty, personal communication) have shown that, on occasion, even "good" bands may be lost. This loss, however, is negligible since, during the course of my study of more than 400 individual quail marked in two ways (neck tags plus leg band), there was no evidence of the loss of a leg band. The bands used were supplied by the California Department of Fish and Game.

For purposes of field recognition of individual quail, a plastic neck tag such as used by Taber (1949) on pheasants was adopted. Since the tags are pinned to the bird through the loose skin at the back of the neck, they are apt to be torn out if they happen to catch in the vegetation. This would be more likely to happen in quail than in pheasants, since the former generally inhabit thicker brush cover. In spite of this objection, a modification of the "Taber tag" proved successful.

These tags were made of a common plastic upholstery material that is available in a variety of colors. They were secured to the bird with a short length of stainless steel wire. The wire was first passed through the eyelet of one tag, then spiralled tightly back upon itself and the short end clipped off. The other end was pushed through a fold of loose skin at the upper side of the base of the neck so that it emerged on the far side of

the spinal feather tract, where it was attached to the other tag. Tags of plastic .02 inches thick and cut to ½ inch by 2¼ inches in size were found to be most efficient. Thinner material became brittle within a few months and cracked off near the base, whereas larger or heavier tags seemed to burden the bird unnecessarily. Tags of this size, if tightly secured through the skin, permitting no more than ½ inch of wire between the bases of the tags, will be exposed about one inch beyond the tips of the contour feathers, thus providing sufficient exposure for an identifying symbol. Single letters or numbers were cut from the same plastic material of a contrasting color and were fused to the tag by heating with an ordinary electric iron. This process turned out to be the weak point of the marking system, since the success or failure of the fusion process could only be established after several weeks. In several instances symbols were fragmented or lost altogether. The success of marking for individual recognition, then was variable. But when a symbol was intact, the identification of individuals appeared to be accurate. Even fragmented symbols were sufficient for recognition in most instances.

Age determination.—Criteria for segregating young from adult California Quail were reported by Sumner (1935). Throughout the first year of life, the presence of juvenal greater upper primary coverts, which are mottled rather than uniform in color, is the best indication of a first-year bird. For a few weeks after these coverts have been dropped, however, young birds may still be recognized, although with less reliability, by the presence of the more pointed distal primaries—the last juvenal feathers to be molted. Thus, it was possible to classify all adult-appearing birds into two age groups: those hatched in a given year and those hatched in prior years.

Young birds in their first summer could be aged much more accurately. Petrides and Nest'er (1943) used the rate of replacement of the primary remiges during the postjuvenal molt of the Bobwhite (*Colinus virginianus*) as a basis for age determination. More recently, Petrides and Nestler (1952) estimated the error of dating by this method to be plus or minus one week until the tenth week of age. Thereafter, the accuracy of the method declined rapidly with the increased variability in the rate of replacement and of feather growth.

The data obtained on the postjuvenal molt of wild California Quail on San Pablo Ridge, together with molt data from captive quail, show that the rates of replacement are close to those described for Bobwhites. This method was used to establish the hatching dates of young quail captured in the summer and early fall months.

Observation and census.—In addition to the opportunity for observation afforded by trapping activity, blinds were set up adjacent to "cock and hen" traps in the spring months to facilitate close study of behavior. Ordinarily, however, traps were watched with binoculars from distances which made careful concealment unnecessary. In the final year of the study, an automobile made an excellent blind from which to watch the quail along the fireroad in Tilden Park (area B). The most intensive and satisfactory studies of marked quail were made in this manner. The area was visited whether for trapping, observation or censusing, on 330 days in all. An annual census was taken in November or early December of the years from 1951 to 1953. Each census was accomplished by three or four men accompanied by dogs. The quail in area A alone were counted as they were flushed up over the drivers. The counts thus secured agreed reasonably well with the calculations of abundance derived from trapping returns for the corresponding periods.

PAIRING

Courtship behavior.—Little has been published on the courtship behavior of California Quail. In spite of an elaborate enclosure set up by Sumner (1935) to study be-

havior, the secretiveness of the birds at this season made observation difficult for him. Stoddard (1931:17), however, was able to observe pairing in Bobwhites under pen conditions. Pair formation was preceded by a frontal display by the males in which "The head is lowered and frequently turned sideways to show the snowy-white head markings to the best advantage, the wings are extended until the primary tips touch the ground, while the elbows are elevated over the back and thrown forward, forming a vertical feathered wall. The bird . . . puffed out to the utmost . . . now walks or advances in short rushes toward the hen." At first, the hens appeared to pay little attention to the males, but "in two cases the first evidence noted of selection was when the hen suddenly squatted and gave a scarcely audible note, and copulation took place. This was repeated frequently, and the pair appeared inseparable thereafter."

In the California Quail, pairing appears to occur primarily within the covey, but no observations of males displaying before females in the manner described by Stoddard were made under conditions that were entirely "natural." Female quail were used as trap decoys for unmated males during the breeding seasons. In almost every instance when the males approached a trap containing such a female, they would display before her, even though briefly, in the following manner: The body feathers would be fluffed out and a low series of "conversational" notes begun. Next, the head would be lowered and extended straight forward and the wings extended from the body an inch or two and drooped until the outer primaries touched the ground. The tail would be elevated to an angle of 45 degrees above the horizontal and the feathers spread out. The subsequent forward rush of the unmated male against the wire of the trap implied a similarity of function to the "rush" in Bobwhites.

The factors which enter into the selection of a mate by quail are difficult to analyze. Observations of penned quail, however, suggest that there may be individual recognition at an early stage of "acquaintanceship." During the spring of 1954, a small group of captive California Quail, brought in from Napa County, were kept in a 20×20 foot pen on the Davis campus of the University of California. This pen was located in the range of a wild population of quail. Among the captives the sex ratio was 6♂♂:13♀♀. From February 23 on through mid-summer, "lonesome" unconfined males were almost constantly seen closeby or atop the quail pen. These males seemed to appear one at a time and take up residence along the side wire of the pen that was closest to the quail roost on the inside. Within a few days the newest arrival would be trapped and released within the pen, whereupon another wild quail would assume the position on the outside of the pen. On March 3, 1954, when the second unmated male took up "residence" beside the pen, it was noticed that a particular female seemed to be responding to the outside male. When he sat on a twig that protruded through the side of the pen, she, too, would perch on the same twig with only the wire netting separating them. When he would drop to the ground from her sight behind the baseboard, she would run back and forth along the inside of the same baseboard, apparently seeking a way to join him. Later the same day, the 19 quail within the pen were marked to facilitate recognition of individuals. On the following morning, the same behavior between the "pair" was seen and, at that time, the female was noted as being yearling number 6710. In the afternoon, the yearling male entered a trap in the baseboard of the pen, was banded number 6727, tagged for easy recognition, and released within the pen. At the next opportunity for observation on March 6, male number 6727 was seen feeding within the pen in close company with female number 6710 and attempting to copulate with her. There seems to be little doubt that the initial phases of pairing in this instance had occurred through the intervening wire netting and that these birds were able to recognize each other despite the shortness of the period of acquaintance.

Stoddard (1931:18) noticed similar behavior among his penned Bobwhites. At the time of pairing "It was noticeable that certain cocks were especially attracted by certain of the hens almost from the first, and even though not necessarily the most successful in combat, they were more persistent in their attentions than the others."

Relationship of prior mating to pairing.—Of the 29 pairs for which there are reasonably complete data, only one pair appeared to remate in two consecutive years. However, only five of these 58 quail were observed for more than one sason; mortality and movement combined to eliminate the majority from further observation.

Adult female number 214 and yearling male number 215 were first captured on August 26, 1951, in trap 7, at which time they appeared to be a mated pair. Subsequently, they were captured together on January 27, 1952, in trap 26, on February 17 in trap 25, and on April 28 in trap 21, at which time female 214 appeared to be laying.

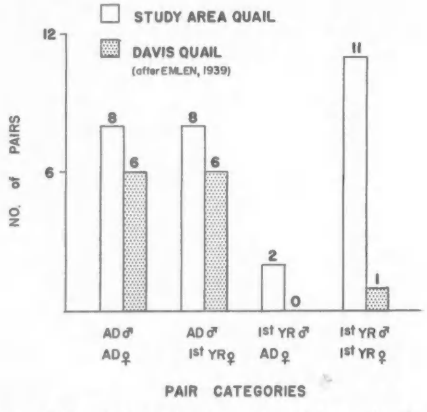


Fig. 2. The relationship of age to pair formation in two populations of quail.

The male was last seen in company with his mate near trap 19 on July 2, 1952. The female was again captured with some old covey mates at trap 2 in mid-September.

On the other hand, there is good evidence that many quail change mates between breeding seasons even though they are closely associated with their mate of the prior season all through the winter period.

Relationship of age to pairing.—An examination of the age class of the members of 29 marked pairs furnishes some interesting clues for speculation on social behavior. In figure 2, the frequency of matings of quail of two age classes, adult and first-year, are shown. The data indicate the infrequency of matings between first-year males and adult females. Indeed, one of two such records is open to some doubt since one pair was not recorded until August 26, at a time of year when the pair bond is difficult to detect. It seems probable that the pairing of first-year males with adult females occurs late in the breeding season in the event of some mishap to the original mate. Pairing prior to covey breakup principally involves the older birds, the younger quail apparently being forced to seek mates elsewhere. Probably this situation is due to an earlier physiological "awakening" of the adult males, such as that encountered in the earlier laying of the older females, which gives them the "jump" on the first-year birds. Matings of adult

males to adult females occurred with the same frequency as that of old males to first-year females. Ostensibly the latter category is a result of the imbalance in sex ratio of the older birds. Emlen's data (fig. 2) for pairs of first-year quail may have been incomplete, since he knew the age of pairs that were seen in the first half of the nesting season but lacked age data for late-season pairs. Pairs composed of first-year birds occurred frequently on San Pablo Ridge. Other factors which combine to produce the sex and age ratios in the population could doubtless profoundly affect the pairing ratios here indicated.

The pair bond.—Pairing normally begins in late February or early March. By the middle of August, the formation of the coveys is well along. By this time also, most of the unmated males have ceased crowing and joined the local group of unsuccessful adults or a family group. Pairs with broods are still held together by their attentions to the young but in adult groups the sexes once again freely mingle during feeding. Fighting between the males is no longer associated with a quick return to the side of a female. Pairs have been combined into groups.

The attachment of the members of a pair for one another increases to a peak in April and May, but dwindles during the summer months. During the early weeks of the breeding season, the attachment of the members of a pair for each other has not yet reached a point where the paired birds remain close together during most of the day. Thus on April 7, 1951, 12 quail, six males and six females, were seen foraging near trap 1. Although the birds were marked and known to be paired, they intermingled freely and without friction. However, only three days later, on April 10, the same birds behaved quite differently. Now the members of the different pairs did not intermingle but were well separated during foraging, and frequent skirmishes were seen between the males. It was evident that part of this behavior was initiated by the presence of at least two unmated males that had joined the group.

By mid-June the members of a pair were very seldom seen to wander more than five or six feet apart during feeding. Practically no intermingling occurred at this season which did not result in skirmishing or fighting between the cocks. The increase in the degree of association between the members of a pair was closely paralleled by the increase in the aggressiveness of the unmated males in the vicinity. Hence the strong pair bond in California Quail may be, in part, a result of the distorted sex ratio which always leaves some males without mates.

CALLING

The principal objective in studying the calls of quail was to seek "indicators" of seasonal behavioral changes. The calls and notes of California Quail are numerous and diverse and have many important functions in the lives of these birds. Sumner (1935: 200-205) has described many of them in detail.

The most familiar call is the "assembly" call. While it is known to be given by both male and female quail during all months of the year, there is a marked seasonality in the intensity of calling correlated with events in the annual cycle. The most intensive calling was found to occur in the fall months during covey formation. Calling declined during the winter, but increased in early spring during pair formation and covey break-up. The use of this call in May and June was principally by unmated males; pairs did little calling unless male and female became separated. Least calling was heard from mid-June until mid-August.

Shortly after the beginning of pairing, each spring, the first "cow calls" were heard. This call consists of a single note that is "similar to the last note of the assembly call" (Sumner, *loc. cit.*) but is louder and usually given only by the unmated males. During

the present study, only one instance of a mated male giving the call was noted. A captive female gave the call on at least two occasions. These instances, however, are probably of infrequent occurrence. The "cow call" apparently functions as an announcement of territory, a matter that is taken up in more detail elsewhere.

The date of the inception of "cow calling" is a reference point for comparing the phenologies of breeding seasons. "Cow calls" usually began in late March, rose to a peak of intensity in May and declined rapidly in early June. First calls were heard on March 20 and 23 in 1951 and 1952, respectively. In 1953, however, the first calls were heard on March 7. This advance in the season was later matched by a similar advance in the hatching dates of young and may have borne some relationship to the success of that reproductive season.

There is little value in the use of the final date on which this call is heard in gauging the duration of the breeding season. After the noticeable decline in calling in June, occasional "cow calling" was heard until late August, but many of the intervening days passed without any calls being heard.

A special effort was made to determine, quantitatively, the date of the peak of call intensity. In general, it appeared that in early season calls were uttered by individual males at a mean rate of four per minute. This rate increased to between six and seven per minute by May, but in any one day there was considerable individual and even hourly differences in the rate of calling. Calling was increased by fair warm weather, by the presence of female quail, and by the calling of competitors. It slowed down noticeably in the absence of these conditions and in midday. In May, however, even poor weather was not sufficient to quiet unmated males entirely. All these variables made the establishment of a peak season subjective.

The "squill call" (Sumner, *op. cit.*:203) also appeared to be given only in the breeding season. This call, however, accompanies the threatening and fighting behavior between the males. It is never uttered as a general declaration, in the manner of the "cow call," but always appears to be directed to a nearby adversary. Its frequency of utterance, therefore, reflects chance meetings and the general social unrest of the breeding season.

A third call associated with the breeding season, the "pseu" note of distress, is considered elsewhere (p. 276). Males displaying before captive females uttered low harsh "throaty" notes that seemed to be reserved for the occasion.

A variety of other calls and low notes were heard during the three seasons. The familiar series of "clicking" notes associated with warning and alarm is given with emphasis befitting the situation at all seasons of the year. Many other calls, usually referred to as conversational notes are scarcely audible at 20 feet from the bird, but appear to function in maintaining contact between individuals of the group.

FIGHTING

Quail fighting is here taken to include every act of animosity from the merest threat to a full-fledged cockfight. In the former category, quail frequently were seen to commit acts which appeared to be reminders to others of their position in the peck-order. This type of behavior, of course, was most frequently seen when the quail were feeding together in flocks in the winter. In chance encounters, one male was often seen to jostle against another or peck gently at another male that came too close to him. Usually the male that was the target of such a slight show of aggression would yield by retreating a short distance. If the aggressor became more perturbed at the presence of the intruding male, a short pursuit might develop.

Threats between males, regardless of social status, were seen to be composed of elements of the display used by the unmated males before trapped females. All elements of this display, however, were not used in threatening gestures to another male. Thus, a slightly lowered head was the beginning of a threat which was clearly "understood" by the recipient. In most instances, however, this type of threat would be followed by a short dash at the object of the threat, to lend emphasis. Drooped wings and ruffled feathers seemed to be a more advanced element of threatening, whereas the elevation and spreading of the tail came last. The erection of the feathers on the crown of the head was thought to be a part of the lowering of the head, but this could not be verified at the distances that observations were usually made. The ruffling out of body feathers, however, was commonly seen. The body, head, and wing positions assumed by the female during copulation are very similar to this. The tail position of the female, however, necessarily differs. Females were also seen to threaten in a manner similar to that of the males.

Full-scale fighting involves behavior which is similar to that seen in other gallinaceous birds. Opposing males face each other squarely and duel briefly but viciously with their beaks prior to leaping up and down in the cockfight. Excited and sharply-delivered "squill calls" quite often accompany the fighting and are invariably given at the completion of the fight. Leaping apparently is an end result of sparring with the beaks to seek an advantage over the adversary. Similar leaping by pheasants and domestic fowls while engaged in fighting is also to gain advantage but more importantly is necessary in bringing the spurs into position for effective use. In the quail, the feet are not used as a weapon, the beak being the sole weapon of offense. It is most often aimed at the nape of the neck of the opponent, where it may do considerable damage if fighting continues for any length of time. The wings may also be active during a pitched battle, but these seem to serve the quail in maintaining balance rather than as a weapon.

Most fights under natural conditions lasted little more than a few seconds and hence had no observable effects on the combatants other than to dislodge a few feathers. Under artificial conditions, as in traps, however, when the "loser" is unable to evade his pursuer, serious injury or death may result. Such an instance was recorded on May 13, 1953, when adult male number 746 was found badly beaten in trap 35 with first-year male number 570. The inside of the trap contained many loose feathers and the back of the adult's head was devoid of feathers. The skin of the nape region had been punctured and was severely inflamed. Stoddard (1931:17) recorded similar instances among Bobwhites in which males trapped in April would be found with "the neck vertebrae . . . picked bare by the victorious cock."

In figure 3, the intensity of fighting is based on two elements. The proportion of the population which is involved in the fighting forms one element. The second element involves the degree of contact between fighting individuals. In general, it appears that the greater the proportion of the individuals that were involved, the greater was the degree of contact in individual encounters.

Defense of mate.—As brought out earlier, most of the fighting that occurred in the quail population from March through June was directly related to pair bond maintenance. Furthermore, it seemed that the great majority of these fights were between mated males and unmated males. The increasing intensity of these fights until the end of May was related to the increase in the aggressiveness of both the unmated and mated males. The interest of the unmated males in pairs, or, at least in the females, was noted by Emlen (1939:126). The result of this interest was a close association of unmated males with pairs during the periods of feeding. This close association repeatedly led to the fighting off of the unmated males by the mated males.

While most of the fighting was confined to the males, females occasionally showed their interest in maintaining the pair relationship intact. On April 10, 1951, near trap 1, a female of a pair that was feeding near a lone male suddenly lowered her head in a threatening manner and dashed at the male. As the latter gave ground rapidly, the female when five or six feet distant from her mate, gave up the chase and returned to his side. A few moments later, the hens of two unmarked pairs that had chanced to draw together while feeding, began threatening one another. Shortly, they became involved in a leaping duel of beaks while their mates looked on. Usually, however, active fighting was restricted to the males at this season.

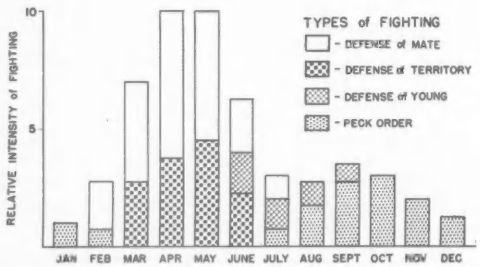


Fig. 3. Frequency distribution of fighting of quail.

The fact that California Quail coveys break up in spring and that pairs spread out over the countryside to nest suggests the possibility that the pair may actively defend the vicinity of the nest against others of their species. Such a conclusion was drawn by Schwartz and Schwartz (1949:51) for the California Quail introduced in Hawaii. "Following separation from the others, the pair spends a month or more selecting a territory, usually within the covey's range, where the female will build her nest and which her mate will defend against intruders."; in addition (p. 59), "cocks will tolerate little trespass in their nesting territories." Such was not found to be the case in the Bobwhite (Stoddard, 1931:27). When suitable nesting sites were limited, several pairs of Bobwhites would nest in a small area. Intensive studies of the nesting Bobwhites failed to reveal them committing any acts that would suggest active defense of the vicinity of the nest against other Bobwhites. Indeed, Stoddard found that two or three hens might commonly lay their eggs in the same nest.

No observations of quail behavior at the nest site were made during the present study, but the available evidence suggests that California Quail, as well as the Bobwhite, do not actively defend a nesting site. Moreover, the females, like the female Bobwhites, are strongly suspected of contributing their eggs, at times, to a common nest (Tyler, 1913:34) and are known to do so in captivity. At the completion of several years of careful observation on this species, Emlen (1939:126) stated: "mated pairs did not set up nesting territories in the usual sense of the term."

The unmated males.—It was Stoddard (1931:97-104) who first noted that, contrary to widespread popular belief, it was the excess males in the breeding population that were responsible for the well-known "bobwhite" call, rather than the mated males. Similarly, the single "cow call" of the California Quail, heard only during the spring and summer months, was noted by Sumner (1935:201) to be given only by unmated cocks. Emlen (1939:126) confirmed Sumner's observation but qualified it when he observed

that the mated male occasionally may give the call when his mate is out of view. Stoddard (*op. cit.*:101), again, was the first to note that "the majority of unmated cocks . . . take up 'territory' from which they whistle day after day." The fact that one of these unmated males was known to move a mile from the original point of capture in a "cock-and-hen" trap, further led him to conclude: "it seems probable that some individuals leave their 'territory' for a short time in search of mates." Emlen's study (*loc. cit.*) of California Quail verified that at least some unmated males of this species were also territorial. He found that of eight unmated males at Davis during the summer of 1937, four "lived in a nomadic existence and four others . . . were decidedly sedentary. Each bird in the latter category restricted itself to a small crowing territory near the nest of an established pair." In the present study, considerable effort was made to learn more of the territorial behavior of these unmated males, of their relationship to breeding pairs, and to the other unmated males referred to by Emlen as "nomadic."

Territoriality.—Perhaps the most obvious manifestation of territoriality by the excess males in the breeding season is the spacing of individuals giving the "cow call." From shortly after the first unmated males were heard calling in March until mid-June, it was possible on any clear day to plot the location of these males on a map. Unfortunately, due to the hilly nature of the terrain as well as to the abundance of heavy cover, it was seldom possible to identify the caller, even if he was banded and marked. Moreover, it soon became obvious that although the majority of the paired quail in the area were usually marked and identifiable, a high percentage of the calling quail were not.

The accumulation of maps shows that up to ten excess males were present and calling on area A at one time, that they were spaced at distances ranging from about twenty feet upward, and that the highest density of unmated males occurred in the area favored by the nesting pairs. Figure 4 contains all the location records of crowing males for the three breeding seasons, 1951-1953, that were plotted in the field. It shows the relative frequency with which different parts of the area were used by these males, and their relationship to the vegetation. The area of the greatest density of dots shows that most of the activity of these males was centralized in the large island of cover adjacent to trap 4, which also was the concentration area of nesting pairs. Relatively little nesting appeared to occur in the draws near traps 14 and 22. In the winter season, however, these draws are the centers of activity of two large coveys. It was also clear that, from the number of callers involved at any one time, "nomads" as well as "sedentary" unmated males were involved.

Territorial fighting between unmated males appeared to be of frequent occurrence. However, interactions of this type in which the identity and status of all of the principal participants was positively known were few. In one case, an adult unmated male (no. 773) who had moved into the vicinity of trap 33 in company with several pairs from trap 35, set up a territory around the principal feeding ground of these pairs. He successfully defended this area against the encroachments of other unattached males (including adult male 754) for more than a month, but mysteriously disappeared in late May. His territory was taken over within a few days by unmated male 754, who thereafter successfully repulsed other unmated males for the remainder of the breeding season.

Male behavior at cock-and-hen traps in the breeding season also reflected the territoriality of many of the unmated males. The usual pattern of response to a calling captive female quail was as follows: an unmated male would call from a distance in response to the female, then fly to the site of the trap. In several instances, the failure of responding males to fly closer than 50 to 100 feet to the trap suggested their concern with some threat near the trap, possibly the threat of an unmated male of superior

fighting ability. Less inhibited males, upon sighting the lone female, would run rapidly toward her. At this point, behavior varied between the assumption of a quiet alert position near the trap (15 instances) or a brief display and headlong rush against the trap wire (3 instances). In either case, there followed a period of inactivity as both captive female and frustrated male quieted down. Within a few minutes, however, this phase would usually be interrupted by the approach of a second unmated male (11 instances).

Fig. 4. Spacing of crowing cocks. Each black dot represents a site from which a male delivered the "cow call" in 1951, 1952, and 1953.

On each of these occasions, the first-arrived male would rush forward to drive the newcomer away. The fact that the outcome of these encounters did not invariably result in the successful repulsion of the second male by the first (the second male in four of eleven such encounters drove the first male off), suggested that the territory-holding male did not always reach the trap first. Hence, any slight psychological advantage the first male might have gained by the brief association with the female (mated males, regardless of size, invariably are successful in repulsing all unmated males) was insufficient to over-

come the fighting superiority of the territorial male. Moreover, the involvement of marked males in some of these encounters supports this conclusion.

On theoretical grounds one would expect that the greatest percentage of unmated males in a population would be first-year birds, since they outnumber adult males. Nevertheless, in the sample of 20 unmated males from San Pablo Ridge (fig. 5) it is seen that only eight of these were yearlings, while twelve were two years old or older, and two were three or more years of age. At Davis in the spring of 1954, another sample of 12 unmated males was taken. These birds were trapped as they appeared beside a pen containing some unmated female quail. Here the first-year males outnumbered the older males by ten to two.

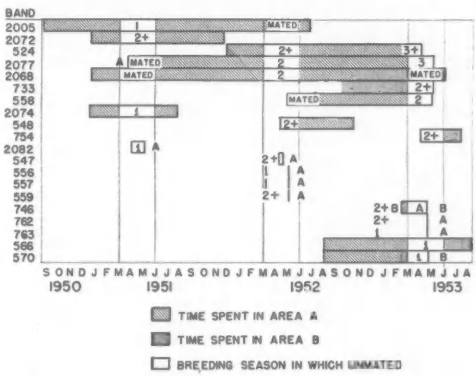


Fig. 5. A summary of the breeding status, age and movements of 20 male quail. The record only includes those males known to be unmated in one or more breeding seasons. Length of the horizontal bar represents the length of the period between first and final observations. A single short vertical line indicates a single observation. Numbers refer to age in years. Capital latters represent study area where observed or captured.

The apparent differences between the two quail populations might be accounted for by the different sampling techniques used. Most of the unmated males captured on San Pablo Ridge were attracted to a cock-and-hen trap. These traps were used at many different trap sites and hence probably in the territories of several older unmated males. Territorial males would be most apt to challenge the presence of strange quail within their area as well as to show interest in unattached females. At Davis, however, all the trapping was in a single locality, thus the trap was available to the unattached or "nomadic" unmated quail, after the removal of the territorial male. In short, the apparent differences of the frequencies of the older males of the unmated category in the two populations, are perhaps not real. The Davis population is hunted and as a result probably contains a larger proportion of young birds, but this difference of itself would not account for great disparity in ratios here obtained.

The predominance of the older males in the sample from San Pablo Ridge suggests that the older males are usually the dominant, territory-holding individuals. Conversely, the nomadic unmated males would be represented principally by yearlings, although

some subdominant adults would be expected in this category. Some support for this is found in figure 5, where it is seen that unmated yearling males, for the most part, had short observation records while the older unmated males had the longer records.

In summary, fighting which involves unmated males is principally concerned with the maintenance of crowing territories. Shortly after the beginning of the crowing season in March, the males may be seen to disperse about the area where they devote a good part of their time for the next three months to giving the "cow call" from a suitable perch. All unmated males, while they appear to be primarily concerned with keeping in close company with paired quail, especially the females, are usually intolerant of other excess males. Two classes of unmated males may be differentiated according to their ability to advertise and defend a territory near the nests or feeding grounds of one or more pairs of quail. Territorial males are usually the older birds, while the "nomadic" unmated males are principally first-year males.

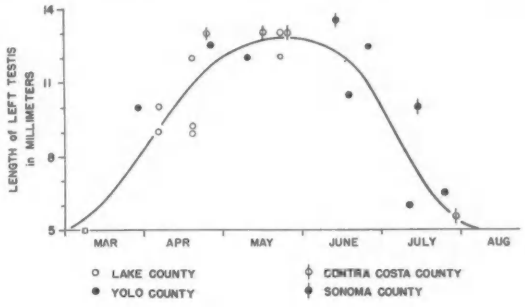
Defense of young.—The solicitousness of quail for their young is comparatively well known. Wild unmated male Bobwhites, when placed in captivity with young quail that were hatched artificially, have been found to "adopt" the young (Stoddard, *op. cit.*:65). Furthermore, parent Bobwhites will vigorously defend their young against enemies much larger than themselves (*op. cit.*:42). Strange quail that attempt to interfere with a brood may also find themselves set-upon by the parents or foster parents of that brood. Similar observations were made on California Quail.

The "pseu" note described by Sumner (1935:205), and given by both young and adults when in distress, almost invariably stimulates a response from other adult quail. In the present study captives that had been removed from traps were kept in bags nearby awaiting their turn to be weighed. In the event that a quail during handling emitted the distress call, the bagged quail would make wild efforts to escape. This behavior would ensue until discontinuance of the notes. On August 12, 1951, an adult male quail being removed from a trap for banding began to give this cry. The response from several wild quail, some distance up a hill in thick cover, was instantaneous. In contrast to Sumner's observation (*op. cit.*:205) that quail in the "free state" crouch down and remain silent when they hear the "pseu" note, these birds gave the same distress notes and moved rapidly down the hill to within eight feet of me, under cover of the brush. By imitating the note, it was possible to cause two of the males to fly up out of the cover, thus exposing themselves to unknown dangers in their excitement. The fact that both the bird that gave the first calls (D2010) and the most agitated reactor (D2087), were adult males suggests that this call is not only associated with parental defense of young but is a releaser of a type of "mobbing" behavior that would be useful in the distraction of enemies. Similar behavior was set off on subsequent occasions by whistled imitations of this note, but the response was not invariable. Moreover, the response of wild quail to the call appeared to be seasonal (fig. 3) and coincided with the period when the young were under the guardianship of the adults.

Fall and winter fighting.—Fighting between quail in fall and winter was concerned with covey formation, and apparently, with individual adjustments within the coveys. Emlen (*op. cit.*:129) noted pitched battles between the members of strange broods that chanced to meet in mid-September. Fighting that involved many quail was seen on the fireroad on October 26, 1952. At this time, the great amount of calling and the excitement of the participants suggested the meeting of two socially exclusive groups. Encounters of this intensity, however, were not observed in mid-winter.

All the fighting and threatening that occurred in the winter months was between males and may have been associated with the establishment and maintenance of social rank. Fighting between two males within a subcovey near trap 33 occurred during the

feeding period on August 2, 1953. All the other members of the group seemed to be compatible and moved along together as a single group. Later in the year in all coveys, the frequent observation of one male threatening another, together with the apparent recognition of the superiority of the aggressor by the subdominant quail, strongly indicated the existence of a dominance order among the males. The existence of such a "peck order" is well known for the domestic fowl and has been reported among females of the Ring-necked Pheasant (Collias and Taber, 1951).



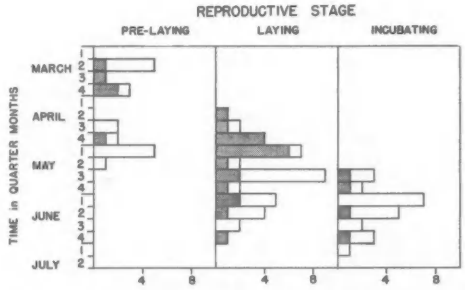


Fig. 6. Above, the testis cycle. Each symbol represents one record. Below, the female reproductive cycle. The data are from birds trapped in 1951, 1952, and 1953. Shaded bars are adults; open bars yearlings.

REPRODUCTIVE CYCLE

Male.—A crude testis cycle has been plotted (fig. 6) from material gathered from several localities during the years of the study. Insufficient data are available for a comparison of yearly phenologies. Since the collection of males from the study area for this purpose was impractical, due to the nature of the study, a few quail were collected in each of the months of the breeding season from nearby in Contra Costa County (5), as well as from Sonoma (2), Lake (8) and Yolo (7), counties, California. The latitudinal spread of this collection is slightly in excess of one degree. The resultant curve corresponds with the cycles in calling and behavior already discussed. The length of the left testis has been used as a basis for comparison as it is usually the larger of the two and

hence can be more accurately measured. Incomplete measurements for some of the specimens collected earlier made comparison of total testes volume, a more desirable datum, impossible.

It may be seen in figure 6 that winter-collected adult males had testes approximately five millimeters in length. The increase in length appears to occur in late February or early March at a time when pairing activities become noticeable. Testis size increases rapidly during March and reaches a peak by late April. The decline in size begins by mid-June, and by the first of August the organs are again back to their minimum size. The rate of decline may be slightly more rapid than that of increase. During seven months of the year, therefore, the testes are in a relatively quiescent state.

Female.—The data for figure 6 were gathered from live-trapped females principally in the breeding seasons of 1952 and 1953 in both area A and area B. Insufficient data were obtained to warrant the comparison of yearly phenologies or to justify a comparison between the females on the two study areas.

The classification of females into three categories, "pre-laying," "laying" and "incubating" is based on a combination of physical characteristics. Weight was one criterion. Hens that weighed less than 200 grams when removed from a trap in April and May usually had not yet begun to lay. The rapid increase in weight at the beginning of laying seemed to be due to two factors. First, the increase in the ovary and oviduct could account for about 16 to 20 grams of the rise in total body weight. The extreme weights of some of the hens, however, were undoubtedly due to their having gorged on the trap bait. Observations of hens at traps supports this conclusion, since they always fed rapidly and seemingly incessantly at this time. In the domestic fowl, laying condition is associated with increased size and content of the alimentary tract.

Additional criteria for classification were the condition of the cloaca, whether large and wrinkled (laying) or small and smooth (not-laying), and the distance between the tips of the public bones, which were about two centimeters apart when the hen was laying and only one centimeter prior to laying. Accompanying the spreading of the pubic bones was an increase in ovary size which was reflected in the increased distance between the posterior tip of the keel of the breast and the cloaca. Gentle palpation of the ventral abdominal region left little doubt of the hen's status if a shelled egg were present in the uterus.

Laying began by the second week in April, reached a peak by the third week in May, and declined through the month of June. During the first month following onset of laying it was notable that only two of nine first-year females had begun to lay, while nine of the eleven older females captured were laying. Lehmann (1953:222) made similar observations on the Bobwhite in Texas. In April and "prior to the May rain" in 1950 and 1951, ten of 16 old females were breeding, while only five of 37 yearling females were breeding. It appeared to Lehmann that "early breeding, . . . on dry range, is principally by older birds with young of the previous year requiring comparatively verdant conditions for general breeding." Four captive adult California Quail at Davis in 1954, that were exposed to the same conditions as six yearling females, also began to lay in advance of the younger birds. It appears, therefore, that this is generally true for two species of quail and may apply as well to other species.

The time of day at which female quail drop their eggs could not be directly determined in the field, but trapping data are suggestive (table 1).

The high percentage of egg-bearing females captured at 6:00 and 7:00 a.m. (Standard Time) indicate that the eggs are usually not dropped until at least two to three hours after the beginning of daily activity and probably not until mid-morning. At Davis, five eggs laid by three different captive females appeared in the following time

Table 1

Hour of the Day and Presence of Shelled Egg in "Laying" Females

Time of day	Female with egg in oviduct	Female without egg in oviduct
5 a.m.	1	0
6 a.m.	18	3
7 a.m.	7	1
8 a.m.	1	1
6 p.m.	1	1
7 p.m.	3	0

intervals: one each between 7:00 a.m. and 2:00 p.m., 7:00 a.m. and 11:00 a.m., and 7:00 a.m. and 10:00 a.m.; two were dropped between 7:00 a.m. and 9:30 a.m. It is quite probable, however, that a cycle in the laying of quail eggs, similar to that of the domestic hen (Hutt, 1949) exists which would mean that there would be considerable variation in the time of laying at different periods of the cycle. Stoddard (1931:26) recognized the existence of such a cycle in the laying of Bobwhites. One female Bobwhite was seen to lay at 9:40 a.m. Other hens, laying in a common nest, "came in to lay at different hours."

The laying records of individual wild California Quail indicated their persistence in renesting and raised the question of the rate at which quail lay. In 1952, adult female D2096, when captured on April 28, was classified as "laying" by her weight and by the appearance of her cloaca, although no egg could be palpated. On May 16, she was definitely laying, as she subsequently was on June 14. It is quite possible that she had ceased laying for a time between captures. On the other hand, it is not known how long she had been laying prior to the earliest date and subsequent to the June capture. In any event, her egg production was probably substantial and eventually resulted in a clutch that was successfully hatched and reared.

Since quail are indeterminate layers, removal of their eggs will result in their continued efforts to complete a clutch. The laying records of eight captive females, kept at Davis in 1954, give an impression of the potential rate of laying. The mean rate of five eggs per week for the captives was constant from the time of the first egg throughout a thirty-day period. At the end of the period, the mean number of eggs per bird was 21.5 and the extremes 16 and 26. It is quite likely, however, that wild quail, better able to select their own diet, would have a slightly higher mean rate.

The appearance of the first signs of the "incubation patch" was cause for placing the bird in the third category, even though laying was still in progress. Careful examination of live-trapped females showed that the incubation patch varied considerably between individuals but had features in common with that of passerine birds (Bailey, 1952).

The first noticeable clue to the development of this area was the loss of down feathers from the lateral ventral apteria of the breast region. Second, in most instances, defeatherization was completed by the loss of the remainder of the down from the apteria and of many of the contour feathers from the ventral tract, thus uniting the lateral and median patches. In this advanced state, the inner surfaces of the upper legs were devoid of feathers as well as the lower abdomen anterior to the cloacal region. This stage was reached, for the most part, in June, after incubation had been in progress for many days. Egg laying frequently accompanied both the early and advanced stages of defeatherization. It seemed, however, that the association of laying with the latter stage was probably coincident with renesting. Since May 27 was the earliest date at which a

fully developed incubation patch was noted, it appeared that incubation must begin prior to the completion of the defeatherization process. However, no direct evidence on this point is available. It was certain that the initial stages of development of the incubation patch did not occur until egg laying had been in progress for several days. Some passerine birds begin defeatherization prior to the inception of egg laying (Bailey, *op. cit.*:125), but the difference in timing is undoubtedly related to the smaller clutch size of these birds. Refeathering of the breast usually occurred during the annual molt, but in one female (no. 560) 75 per cent of the contour feathers of the ventral tract were being replaced on June 14, 1952, prior to the normal season of the female annual molt.

Increased vascularization of the dermis (Bailey, *op. cit.*: stage II) seemed to follow closely upon the loss of the down feathers, but it varied considerably among females. At this time, the skin of the breast varied in color from pink to yellowish and was dry, flaky and wrinkled. The enlarged blood vessels were easily detected in a few of the birds but they were difficult to see in others. Quail incubation patches did not appear to be edematous nor did the thickness of the skin appear to increase, but no histological examination was made to verify this point.

Since male California Quail have been reported to incubate in the event of the disappearance of the female (Price, 1938), the breasts of the males also were examined at this season. One male only (no. 767) was seen to have lost feathers from the breast region but not to the extent seen in the females. This loss of feathers by a male might be due solely to wear during incubation. There was nothing comparable to the vascularized brood patch of females.

MOLT

Postjuvenal.—In quail, as in other galliforms, the replacement of the remiges, during the postjuvenal molt, progresses in an orderly sequence beginning with the proximal primary (no. 1) and ending with the replacement of primary no. 8. The molting of all other feather tracts is completed within this period of time. Dwight (1900:49) noted that the two distal juvenal primaries, numbers 9 and 10, together with the greater upper primary coverts, were retained throughout the first year. Petrides and Nestler (1943) described a method for determining the age of young Bobwhite based on the rate at which this wing molt progresses. Since their data were derived from captive quail of a different species, it was desirable to determine the applicability of their data to California Quail. The molt stage of all young quail captured more than once during one postjuvenal molting period on San Pablo Ridge provided the data for one of the replacement curves in figure 7. Since the precise age of these quail was not known, it was necessary to ascertain the age at which molt normally began in order to relate the curve to quail age.

Nineteen California Quail reared in captivity at Davis in the summer of 1954 provided the data for the second replacement curve. Because captive Bobwhites as well as captive Capifornia Quail were known to commence the postjuvenal molt at 28 days of age, the replacement curve for the wild quail was adjusted to the same datum point. The curve for Bobwhite was constructed from Petrides' data (*op. cit.*). Although the three curves do not differ significantly, the two curves for California Quail suggest the effects of captivity in retarding molt rate.

The tail molt offers a clue for the aging of young quail in the field, for a short period of time. Because tail molt in this species is centrifugal, the tail may appear "forked" in flight for a time after the beginning of the eighth week. The central feathers are dropped first, hence retention of the long outer juvenal rectrices is responsible for this appear-

ance. Young quail exhibiting this condition are usually between eight and eleven weeks of age.

Young quail in full juvenal plumage could not be sexed from appearance. By the sixth week of life, however, the appearance of the first few black feathers just below the eye in the cheek region was the first obvious indication of "maleness." New brown feathers in this region and at this age, were a slightly less obvious criterion for females. Male head plumes may be slightly longer, at an earlier age, than those of the females, but this is not an infallible key to sex recognition.

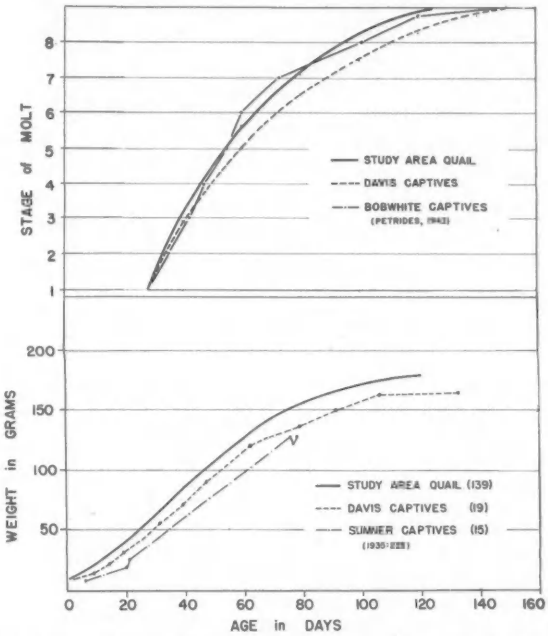


Fig. 7. Above, the postjuvenal molt. Molt stages correspond to the dropping of the juvenal primary of the same number. Below, growth curves.

Annual.—Unlike the postjuvenal molt, the annual molt of adult quail normally is complete. It resembles the postjuvenal molt, however, in that within the span of time required for the replacement of the ten primaries, the molting of all other feather tracts is completed. The stages of primary replacement, therefore, are a handy standard for comparison.

Figure 8 includes all the molt data for the three-year period. Male annual molt begins, almost invariably, in mid-June and is completed by mid-October. Sumner (1935: 250) apparently overlooked wing molt in observing that "the fall molt commences about the first week of August." The paucity of female records in the early stages of the molt is unfortunate, but by extrapolation, it is seen that they normally commence molting about one month later than the males. The extreme "scatter" of female records

seemingly reflects the frequent occurrence of renesting attempts (fig. 8) that would retard molt. Whether or not the females, once started, molt at a faster rate than the males, as indicated by the convergence of the two lines (fig. 8), is not clear. All females caught later than November 9 appeared to have completed their molt, as had the males. There was no clearcut relationship with age, or with success in breeding, in the timing of the annual molt in females. Paired and unmated males regardless of age likewise appeared to begin the annual molt at the same time.

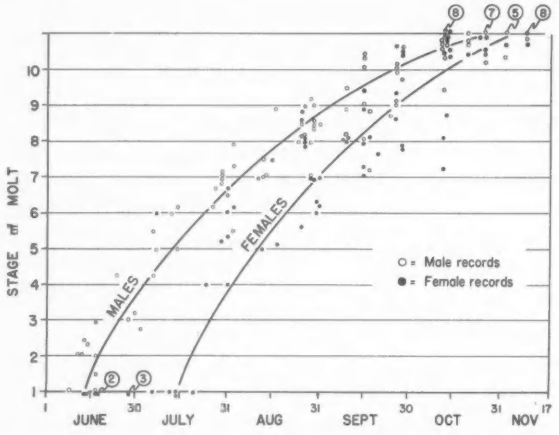


Fig. 8. The annual molt. Molt stages correspond to the dropping of the primary of the same number.

The similarity of the replacement rates of the postjuvenal and annual primary molts, together with the possibility that the inception of the female molt may coincide with the completion of brooding of young, suggests that the wing molt stage of a female and her brood might also coincide. One brood, reared in captivity by its two parents, lagged only six days behind the adult female in wing molt progression. Four wild females, on the study area, however, began molting from 16 to 36 days ahead of their "broods." It seems that the annual molt of females probably begins in the wild between the time of hatching of the young and the inception of their postjuvenal molt.

GROWTH AND WEIGHT

Growth of young.—No attempt to take linear measurements of wild juvenal quail was made, hence "growth," in this instance, is expressed as the increase in total body weight. The curve representing the fastest growth rate in figure 7 was obtained from the records of 139 juvenal quail captured in the three seasons of the study. The age of each individual was gauged from the stage of wing molt. Sumner (1935:225) earlier published a table of weight increases of 15 pen-reared quail that also appears in the form of an incomplete growth curve in figure 7 for comparison. Because of the objection of using the weights of quail whose age was not precisely known, additional data were obtained on the weight increases of 19 pen-reared quail at Davis in the summer of 1954 to serve as a further check.

The similarity of the three curves is obvious. While they represent the means of the growth-time relationship for each group, weight variability of each group overlapped

considerably. As one might expect, however, the wild quail appear to gain weight most rapidly, increasing at about two grams per day until they are nine-tenths grown. At this time, they are approximately three months of age. The fact that many of the captive quail lagged well behind the wild quail in gaining weight is undoubtedly a reflection of the necessity for eating that which was offered to them rather than being able to select their own food.

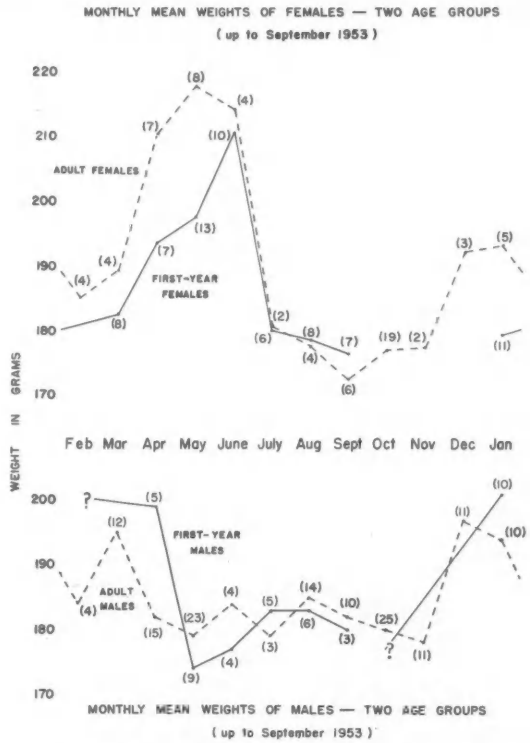


Fig. 9. Monthly mean weight curves. Numbers in parentheses represent sizes of samples.

Adult weight changes.—In figure 9, the monthly mean weights of more than three hundred live-trapped quail have been summarized. The records of first-year males and females were started in January, well after the period of rapid juvenal growth, and they followed through the first breeding season. Two peaks are present annually in the female weight curves. The first occurs during the breeding season and is thought to be coincidental with egg-laying. The lag in the weight increase of first-year females supports the earlier observation that these birds, by and large, commence laying slightly later than do the adult females. The early breeding season peak is followed by a rapid decline, supposedly induced by the stresses accompanying reproduction. The second rise in weight took place in all sex and age groups during the winter season. This increase

may be the result of the shift in diet (Sumner, *op. cit.*:178) that normally occurs at this season. November rains invariably result in the germination of annual grasses, which shortly become an increasingly important item of quail diet. Males undergo a sharp decline in weight in early spring. This may reflect behavioral changes associated with the pairing and fighting of the breeding season. Here, again, the first-year bird's weight change follows that of the adult.

SUMMARY

A three-year banding study (1950–1953) of the California Quail (*Lophortyx californica*) near Berkeley, California, provided the opportunity for observations on the annual behavioral patterns and physiological changes of these birds.

California Quail are monogamous but usually seek new mates each spring. Pair formation may be accompanied by a frontal display of the male before the female of his choice. The pairing birds appear to be able to recognize each other at an early stage of their relationship. First-year males rarely mate with older females, but older males mate as frequently with first-year females as with older females. Pairs composed of first-year birds were most abundant. The pair bond is strongly maintained by both members of a pair during the breeding season.

The function and seasonality of certain calls are considered. The date of the inception of "cow calling" was found useful in comparing the timing of three breeding seasons.

Threatening and fighting occurs between individuals at all seasons of the year. In the spring and summer these social interactions are most frequent and heated: paired birds fight off intruders to maintain their bond and to defend their young; unmated males fight to maintain territory in the vicinity of nesting pairs. In the fall and winter, fighting is concerned with the attainment and maintenance of social rank within the covey.

Testis size increases rapidly in March, reaches a peak by late April and regresses in July. Egg-laying begins by the second week in April and declines through June. The older females begin laying about two weeks earlier than the first-year birds. Defeatherization of the breast accompanies egg-laying in the female and is followed shortly by an increase in vascularization of the dermis to form an incubation patch. Males do not develop a comparable incubation patch.

The sequence of replacement of the primaries during the postjuvenal molt offers a useful clue to the age of the young bird. The sex of live "chicks" cannot be easily determined until the sixth week. The annual molt of adult males begins, almost invariably, in mid-June and is completed by mid-October. Females begin the annual molt after their young have hatched or about one month later than the males.

Young quail gain weight at approximately two grams per day until three months of age. All first-year and adult quail attain peak weight in midwinter. Laying females attain maximum weight while their mates are declining in weight.

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MAJOR ARTERIES NEAR THE HEART IN THE WHOOPING CRANE

By HARVEY I. FISHER

The basic pattern of the arterial system in birds has been well known for some time, but ordinal, familial, and specific differences were little known until Fred H. Glenny started his investigations some 15 years ago. Even now we have no knowledge of the circulatory systems of perhaps two-thirds of the species of birds. Many of the data for a species have been based on but single specimens. Therefore, it seems important to record even fragmentary bits of information about species whose circulatory systems are entirely unknown.

Until Glenny's papers of 1945 and 1947, the thoracic and cervical arteries of gruiform species were largely unstudied. Du Verney (1733) noted that the tracheal artery accompanied the trachea into the sternum in the "Grue d'Afrique." Rathke (1850) dissected "*Grus cinerea*" and apparently found the usual bicarotid condition; he did not specifically state this, but he did not include this species in his list of exceptions to the characteristic double carotids. In 1873 Garrod found both carotids in *Grus antigone* and wrote that this condition was constant within a single genus. Gadow (1891:777) concluded that gruiform birds had two "carotides profundae" but did not have two "carotides profundae conjunctae," a "carotid superficialis sinistra," a "carotid profunda dextra," or two "carotides superficiales." Gadow's conclusions were seemingly based in large part on dissections of "*Grus cinereus*," although one cannot be certain. In his study of the cerebral arteries of birds, Beddard (1905) discussed *Anthropoides*. Glenny (1945) described and figured the thoracic arteries of *Grus antigone, Anthropoides paradisea, Fulica americana,* and in 1947 *Rhynochetos jubatus*.

The purpose of this study is to record the major arteries found in three Whooping Cranes, *Grus americana*. The origin of these specimens is given by Fisher and Goodman (1955). We can not expect many specimens of this rare and nearly-extinct species; therefore, study of all organ systems was attempted. Work on the blood vessels was difficult, for no special vascular injection had been made, and the specimens were variously preserved (in alcohol, frozen, or in formalin) before I received them.

There is little need for detailed descriptions which in large part would duplicate Glenny (1945). Comparison with his descriptions will be used to point out apparent differences between the species, between the individual Whooping Cranes, and even between the two sides of the same Whooping Crane. Figure 1 is of crane number 1; figures 2 and 3 depict the left and right sides of crane number 2. Crane number 3 showed no features not present in one of the illustrations, but the arteries in this bird were not identical to those of the other specimens.

Grus antigone and all specimens of *Grus americana* agree in the basic origin and interrelationships of the innominate arteries and the right aortic arch (fig. 1) and in the division of each innominate trunk to form the common carotid and subclavian arteries. *G. antigone* apparently has a definite section of artery which can be termed the subclavian trunk. The subclavian arterial trunk is not uniformly present in *G. americana*. Figure 3 shows the subclavian present and well developed on the right side of Whooping Crane number 2; the left side of the same bird (fig. 2) demonstrates the opposite extreme, the innominate ending abruptly in four distinct branches. Bird number 1 (fig. 1) and the third crane also indicate this asymmetry; the subclavian artery is better developed on the right than on the left side.

The subclavian artery gives rise to the axillary, coracoid major, pectoral, and intercostal arteries. However, the position of origin of the branches in *G. americana* is dif-

ferent from that in *G. antigone*. In all specimens of *G. americana* the sequence from anterior to posterior is axillary, coracoid major, pectoral, and intercostal. Glenny (1945: fig. 1) gave the series in *G. antigone* as axillary, pectoral, intercostal, and coracoid major. In order of origin from proximal to distal the series in *G. antigone* is coracoid major, coracoid minor, axillary, intercostal, and pectoral. In *G. americana* all may arise at the same place (fig. 2) or the sequence may be axillary, coracoid major, intercostal, and pectoral. No coracoid minor artery was found in *G. americana*. It may be that this artery arises from the axillary as Glenny (1945:267) described for *Anthropoides paradisea*, but it is also possible that it comes from the coracoid major artery, all the branches of which I could not trace. In the Whooping Crane the relative points of origin of the

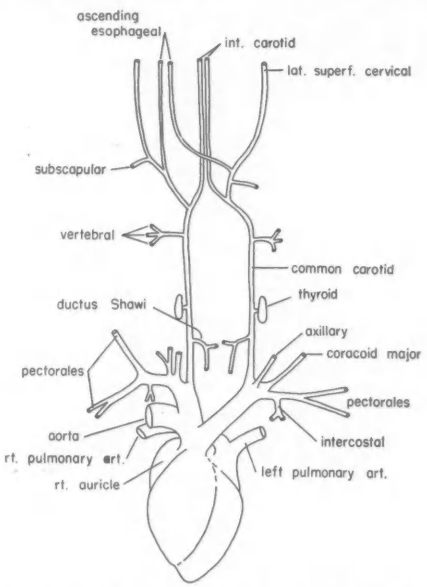

Fig. 1. Ventral view of the heart and proximal arteries of a Whooping Crane (bird no. 1).

major arteries branching from the subclavian varied individually and between the two sides of the same bird (compare fig. 1 with figs. 2 and 3, and compare origins shown in fig. 2 with those in fig. 3). These variations seem to be correlated with differences in the development of the subclavian trunk. The axillary artery is always a separate vessel, but the coracoid major may come off the subclavian artery near the base of the axillary (fig. 2) or farther distad, near the origin of the intercostal and pectoral arteries (fig. 3). On four of the six sides dissected, the intercostal arteries can be said to arise directly from the subclavian (figs. 1 and 3); on the other sides the intercostals originate as medial branches of an arterial trunk which continues ventrally to form the main pectoral arteries (fig. 2).

The axillary artery divides typically into two trunks—the brachialis and the humeralis. These arteries could be traced in only one of the Whooping Cranes, but there was

considerable variation in the distribution of the branches. On the left side of this specimen (fig. 2) the brachialis artery sent two distinct branches to the biceps muscle and one to the coracobrachialis anterior muscle. On the right side (fig. 3) the major vessel to the biceps came off the humeralis artery, and M. coracobrachialis anterior was supplied by a branch of the coracoid major artery. On the right side a branch of the brachialis artery carried blood to M. deltoideus minor, but on the left side this muscle was supplied by an artery arising from the coracoid major artery. Other distributions of branches of the humeralis artery were identical on the two sides of this crane.

The coracoid major artery divides shortly after it arises. One artery always supplies the supracoracoideus muscle; the other, smaller twig goes to the subcoracoideus and deltoideus minor muscles (fig. 2) or to the sternocoracoideus and coracobrachialis posterior muscles (fig. 3). In figure 2 note that these latter muscles are served by an artery coming off the intercostal artery.

As Glenny described for *Grus antigone* and *Anthropoides paradisea*, the intercostal and pectoral arteries in *Grus americana* divide almost immediately after their origin.

No trace of the ligamentum aortae or of the right ligamentum botalli was found in any of the Whooping Cranes. An intensive search was made, and this region was fairly well preserved in the specimens. Glenny (1945:267–268) reported both these ligaments

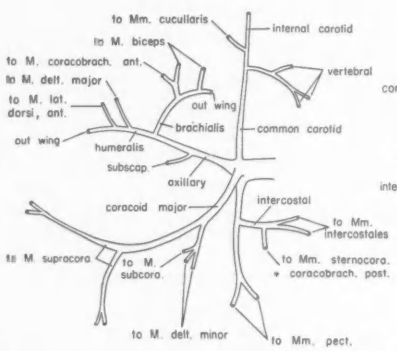

Fig. 2. Dorsal view of the proximal arteries of the left side of a Whooping Crane (bird no. 2).

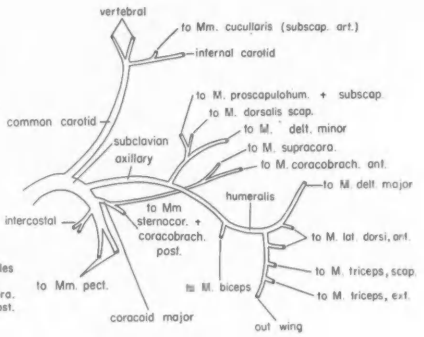

Fig. 3. Dorsal view of the proximal arteries of the right side of a Whooping Crane (bird no. 2).

"present and prominent" in *Grus antigone* but only the ligamentum botalli in *Anthropoides paradisea*. Both are present in *Fulica*. Presence or absence or relative development of such transient, embryological structures is perhaps of little significance.

Although the term "common carotid" is used in the illustrations to denote a definite trunk or vessel, it should be noted that probably only the base of this trunk constitutes the common carotid. Just how far the common carotid extends distally from the original embryological arch is open to question. In any event, the right and left carotid trunks send off small ductus shawi vessels (fig. 1), the posterior ends of which were not traceable. The medial twigs from the ducti represent some of the syringotracheal arteries. Small vessels go to the thyroid, and still farther anteriorly one or more vertebral arteries arise from the carotid trunk. All three Whooping Cranes were the same as regards these details of the carotid.

Only one of my specimens was suitable for tracing all the major anterior branches of the internal carotid trunk. However, this specimen differs from the species of cranes described by Glenny. In *Grus americana* the vertebral arteries are produced from the carotid artery proximal to the origin of any of the esophageal or cervical arteries. In *G. antigone* and in *Fulica* the vertebrals arise anterior to these latter arteries. In *A. paradisea* the vertebral vessels come off the carotid between the origins of the superficial cervical and the accessory ascending esophageal arteries.

The ascending esophageal artery in the Whooping Crane comes from a common trunk which also gives rise to the subscapular (scapular) artery and the lateral or superficial cervical artery. The left ascending esophageal artery passes over the ventral surfaces of the internal carotids to go anteriorly alongside its counterpart of the right side. This esophageal artery of the right side is apparently absent in the cranes dissected by Glenny or is represented by his accessory superficial cervical artery which is present only on the right side in *Grus antigone*.

Glenny (1945:267) found that the scapular artery arises from the superficial cervical artery in *G. antigone*. This was also the case in one Whooping Crane (fig. 1); in another Whooping Crane the scapular came directly from the internal carotid (figs. 2 and 3, labelled "to Mm. cucullaris").

SUMMARY

The limited results of this study demonstrate that there is considerable interspecific variation in the arteries near the heart in cranes. But it is thought that much of what appears to be interspecific variation may really be individual variations, such as that shown in the Whooping Cranes here described. The Whooping Crane typically shows the bicarotidinae normales condition postulated as characteristic of the order Gruiformes by Garrod, Gadow, and Glenny. However, this species is not like *Grus antigone* or *Anthropoides paradisea* in the manner of origin of the accessory ascending esophageal and vertebral arteries. Both these origins, as described by Glenny, were considered by him to be characteristic of birds of the order Gruiformes. The bifurcated intercostal arteries are apparently characteristic of all cranes thus far dissected.

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OBSERVATIONS ON PELAGIC BIRDS OF THE NORTHWEST PACIFIC

By NAGAHISA KURODA

In the summer of 1954 I had the good fortune to accompany the Japanese Fisheries Agency's 78-ton research vessel, Geizan-maru No. 8, on a 34-day voyage through northwest Pacific waters to investigate the northward migration of fur seals from their wintering grounds off Japan to their breeding islands in the Bering Sea. This paper reports the ornithological investigations I was able to make with the help of my companions. My thanks are due particularly to the Fisheries Agency officers, Messrs. Shiro Yoshizaki and Fukuzo Nagasaki, and to Mr. Osamu Izawa, who was the supervisor of the fur seal investigations.

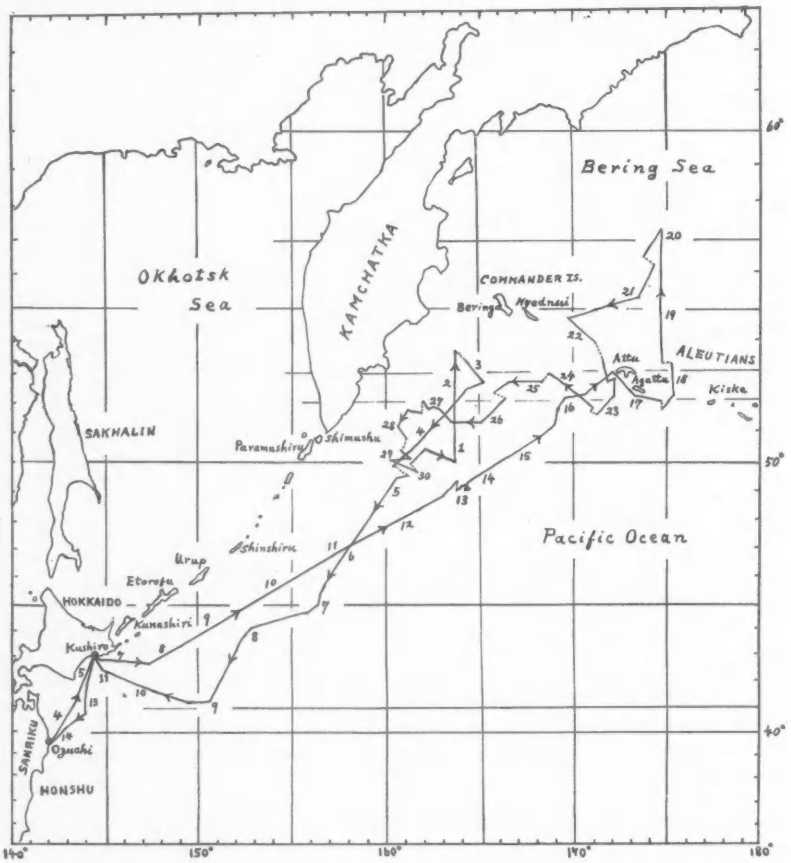

Fig. 1. Voyage of the Geizan-maru No. 8. The numbers along the ship's track are dates, ranging from June 4 to July 14, 1954. The dotted lines show the ship's drift when hove to at night.

The accompanying map (fig. 1) shows our itinerary. Leaving Ozuchi on the northeast coast of Honshu on June 4, we put in at Kushiro, Hokkaidó, for a day and left there on June 7 for the Aleutians. We sailed north between Agattu and Kiska into the Bering Sea and reached our northernmost point, 57° 28′ N, on June 20. There we turned southwestward toward the Commander Islands and then southeastward to Attu waters, whence we worked westward, south of the Commanders and east of southern Kamchatka until July 4. On the return voyage we cruised south until we reached the edge of the warm current 240 miles southeast of Etorofu Island on July 9. From there we headed into Kushiro again, and thence back to Ozuchi, reaching our starting point on July 14 after logging 6000 nautical miles.

Throughout the voyage we were favored by good weather. Winds were generally moderate, often being just strong enough to dispel the heavy fogs so prevalent in these waters. They reached velocities of 5 or 6 meters per second only during the few days we encountered low pressure areas off South Kamchatka. The rest of the time the seas were fairly calm.

Air temperatures ranged between 8° and 9° Centigrade during the days and dropped from 3 to 5, and sometimes, when clouds thinned, to 10 degrees lower at night. Our warmest days were June 10 and July 4, when the clouds thinned enough to allow a weak sun to raise the air temperature to 13°C. Our coldest period was from June 7 to 11 off the Kuriles, where the cold current from the Okhotsk Sea remained at 2° to 4°C.; the night air temperature also never varied beyond those limits. After we crossed the northeast-southwest tide lines 180 miles southeast of Attu on June 15, we found relatively warmer waters, 5° to 6°, rarely 7°, in the Aleutians and the Bering Sea. As usual the skies were constantly cloudy, and until we reached summer weather again at the warm current on July 12 we saw the sun set only once, on June 12. The short nights, averaging only 7 hours, allowed long hours of daylight for bird observations.

Because this was the breeding season of northern species and because we remained well away from land throughout the voyage, the numbers of birds observed were comparatively low. Often we sailed for hours without seeing a single bird. In the cold waters off the Kuriles the number of species seen each day averaged 4.5, with extremes of 3 and 8. In the northern seas we usually recorded from 7 to 11 species daily, with a high of 12. When we reached the warm current on July 9 the daily total increased to 13, including a few cold-current species.

As will be noted in the list, the distribution of most birds was correlated primarily with water temperature, to a lesser extent with air temperature, and least of all with wind direction and velocity. The only species whose movements seemed to depend on the wind was the Slender-billed Shearwater (*Puffinus tenuirostris*), which was usually on the water and not in the air on calm days. The commonest and most widespread species was the Fulmar (*Fulmarus glacialis*), which was observed daily throughout the voyage; it was never absent from any list, and it seemed to fly wherever it wished regardless of wind and weather.

A rough measure of comparative population densities is afforded by dividing the number of each species observed by the hours of observation, for the ship maintained a fairly steady 7.5 knots during daylight hours. The highest densities were found in the Attu-Agattu waters (36 to 100 individuals per hour) and southwest of the Commander Islands (26 to 118 per hour). In both these areas the irregular currents contained an abundant supply of food, as indicated by our plankton collections, and the birds collected often had their stomachs filled with a species of *Euphausia*.

North of the Aleutians the bird density in the Bering Sea dropped to 4 to 6 individuals per hour, and it did not increase to 20 until we approached the Commander

Islands. South of these islands it ranged from 18 to 24 individuals per hour. In the cold current off the Kuriles the densities were comparatively low, from 4 to 15 per hour, increasing only once to 22 off Shinshiru where the Crested Auklet (*Aethia cristatella*) was locally plentiful. In the warmer offshore waters as we sailed southward, densities increased to 32 to 47 as the two albatrosses increased in abundance. Along the periphery of the warm current, abundance dropped to 21 per hour, but here we obtained some of our most interesting records: the two Australian petrels *Puffinus bulleri* and *Pterodroma solandri* collected for the first time in this region, an unexpected northward extension of the range of *Synthliboramphus wumisuzume*, and a radical change in the specific composition of the pelagic population.

ANNOTATED LIST OF SPECIES

Diomedea nigripes. Black-footed Albatross. This species ranges chiefly in the warmer waters south of the main range of the Laysan Albatross at this season. It is common in Japanese waters and we found it mostly where the air ranged between 17° and 22.5° and the water between 8° and 16°, seldom where the water was below 10°. Northward we encountered it but rarely. It seems to rest on the water more than does *immutabilis*, and I saw one swimming bird dive for several seconds after a sinking bait with its long wings half spread. Specimen: ♀, July 8, 1954, 43° 26′ N, 151° 41′ E, wt. 2090 gm. Observations:

Date	Locality	Temperature °C. Air	Water	Number seen
June 4	Off northern Honshu	17	13	8
June 5	45 mi. SW Kushiro	14	5	2
June 29	200 mi. E Paramushiro	11	6	1
July 2	200 mi. E s. Kamchatka	9	5.1	1
July 7	200 mi. ESE Paramushiru	13–15	7–8	2
July 8	150 mi. SE Etorofu	7–8	6–7	1
July 9	240 mi. ESE Kunashiri	17–22	15–16	11
July 10	140 mi. ESE Kushiro	18–21	8–9	2
July 11	13 mi. S Kushiro	7	8.2	1
July 13	50 mi. SW Kushiro	17	10–11.5	10
July 14	Off northern Honshu	17–22	12.5	9

Diomedea immutabilis. Laysan Albatross. This species was most plentiful 180 to 200 miles east-southeast of Shinshiru Island, where we saw 14 birds in one day. From this point northward we encountered only five single individuals along the Kuriles and none in the Bering Sea. Southward to northern Japan it was not plentiful. The species seems to avoid water above 13° and air above 17°. Specimen: ♀, July 7, 1954; 44° 56′ N, 155° 50′ E, wt. 2630 gm.

Date	Locality	Temperature °C. Air	Water	Number seen
June 4	Off northern Honshu	17	13	1
June 18	50 mi. E Agattu	6.2	5	1
June 23	18 mi. SW Attu	9.2	6.8	1
June 30	250 mi. E Paramushiru	11	5.8	1
July 1	250 mi. E Paramushiru	9.5	5	1
July 5	180 mi. ESE Paramushiru	11	5.5	1
July 7	200 mi. ESE Paramushiru	13–15	7–8	14
July 8	150 mi. SE Etorofu	7–8	6–7	1
July 9	240 mi. ESE Kunashiri	17–22	15–16	3
July 13	50 mi. SW Kushiro	17	10–11.5	1

Fulmarus glacialis rodgersii. Fulmar. This was the commonest bird encountered throughout the trip. Numbers counted daily ranged from ten to hundreds, in concentrations of from 1 to 77 per hour, the numbers being lowest in the warmer waters and at our point farthest north in the Bering Sea. The heaviest concentrations were found in Agattu-Kiska Strait (6.9 per hour), east of the Commander Islands (12.3 per hour), west of Attu (hundreds feeding at dawn, June 23), and in the waters

east of southern Kamchatka, where from 20 to 77 per hour were counted between July 2 and 6. The species was commonest in air temperatures between 5° and 14° and in water temperatures between 3° and 8°. The southernmost concentration was noted off the Hokkaido coast, where on June 5 and again on July 11 between 100 and 200 were counted in the cold current. In warmer air (up to 22.5°) and water (up to 12.5°) encounters were sporadic.

In typical flight the Fulmar rises fairly high above the water surface with stiff wingbeats and then glides down slowly. In a dead calm it may glide long distances almost touching the surface in the manner of shearwaters. Solitary birds were encountered frequently resting on the water, sometimes sleeping with the bill inserted in the back feathers until the ship passed close to them. They followed the ship often, circling around it continually and rushing immediately to any refuse thrown overboard. One calm evening when we stopped the ship they gathered to bait thrown to them and approached within a meter of the stern. They were easily caught on a hook and line, and we released immediately the several we caught that way. One after another came by in a low glide, braked to a stop with fast wingbeats near the bait, swam to it with lowered tail, and then dashed off to eat the prize at a distance. I never saw one dive.

The white phase of the Fulmar is rare in the western Pacific. Of more than 2180 Fulmars observed on the trip only 38 (1.7 per cent) were white. One of these was seen in Japanese waters, one off the middle Kuriles, the rest east of the Commanders and off Kamchatka. The two white phase birds I collected were both females, as was one I collected off Hokkaido in 1950, which suggests this coloring may be sex-limited. Specimens: ♂, June 5, 1954, 5 mi. off Kushiro, wt. 653.6 gm.; ♂, testes large, June 13, 1954, 48° 54′ N, 162° 06′ E, wt. 771.4 gm.; ♂, testes large, June 13, 1954, 48° 54′ N, 162° 06′ E, wt. 589 gm.; ♀, ovaries small, white phase, June 23, 1954, 52° 45′ N, 172° 06′ E; ♀, ovaries small, white phase, June 27, 1954, 51° 48′ N, 162° 50′ E.

Calonectris leucomelas. Streaked Shearwater. This species was seen only off northern Honshu. On June 4 a few miles off Yamada Bay we saw a thousand or more in waters where sardines were schooling. This is about 20 miles north of the breeding colony on Sanganjima, near Ozuchi. North of this the same day we saw only a few scattered individuals, and after that no more until we returned to these waters on July 14. The air temperatures there ranged from 19° to 20°, the water from 12° to 12.5°.

Puffinus carneipes. Pale-footed Shearwater. This is a warm temperature species, not seen in the north. Our records:

Date	Locality	Temperature °C. Air	Water	Number seen
July 9	240 mi. SE Kunashiri	20.7	16	1
July 13	50 mi. SW Kushiro	17	11–12	8
July 14	Off Honshu	20	12.5	7

Puffinus griseus. Sooty Shearwater. This species was abundant off the coast of northern Japan, but it was not seen in northern waters. Off northern Honshu we encountered small flocks during the morning, usually resting on the water. It feeds at dawn near the land where food is abundant and then scatters offshore during the day.

Date	Locality	Temperature °C. Air	Water	Number seen
June 4	Off northern Honshu	19	12	hundreds
July 10	130 mi. ESE Kushiro	20	12	9
July 11	13 mi. S Kushiro	7	8.2	few
July 13	39 mi. SW Kushiro	17	11.2	1
July 14	Off northern Honshu	20	12.5	hundreds

Puffinus tenuirostris. Slender-billed Shearwater. This was the commonest of the shearwaters in northern waters, usually being found singly and in small groups, occasionally in company with Fulmars. It usually flies obliquely with the wind, veering right and left in an S pattern. In stronger winds it occasionally flies obliquely into the wind, often turning in complete circles as it proceeds.

The first observed were three birds about 240 miles southeast of Paramushiru at latitude 48° N on June 12. North of that we recorded the species daily. On the return voyage it became markedly less plentiful south of 48°N. We saw 2 about 190 miles east-southeast of Shinshiru on July 8, 7 some 130 miles southeast of Kushiro on the 10th, 100+ in company with flocks of *P. griseus* on the 11th off Kushiro and on the 14th off the Honshu coast.

Its normal abundance was 10 to 50 per day, or 1 or 2 to over 10 individuals per hour. But 100 miles southwest of Attu on June 16 we counted 481 birds (46.6 per hour), and west of Attu at dawn on June 23 we met a huge flock of about a thousand feeding on *Euphausia* in company with Fulmars. Its numbers decreased rapidly as we sailed away from this area of abundant food supply, but it was fairly plentiful in Agattu-Kiska Strait, where we counted 126 birds (15.8 per hour) on June 18.

Northward in the Bering Sea from June 19 to 21 its occurrence was sporadic, ranging from 7 to 16 per day (1.7 to 2.5 per hour), but as we approached the Commander Islands on the 22nd we saw 30 (3.2 per hour). It was plentiful again from 120 to 180 miles southwest of the Commanders, where on July 1 we counted 130 (17.9 per hour) and on July 2, 285 (55.9 per hour), resting on the water or flying by in small flocks. A flock of about 100 birds encountered some 180 miles southeast of Paramushiru on July 6 was the southernmost of the main northern group seen.

We counted conservatively about 2020 individuals during the voyage. The species' distribution in the north showed little correlation with either air temperatures (6° to 11.5°) or with water temperatures (3.5° to 7°). Those seen off the Japanese coast at the end of the voyage were in air of 17° to 20° and water of 8° to 12.5°. Its abundance seems correlated rather with the available food supply. Specimens: ♀, June 16, 1954, 50° 18′ N, 169° 53′ E, wt. 570 gm.; ♀, June 23, 1954, 52° 48′ N, 172° 06′ E, wt. 855 gm. (stomach crammed with food).

Puffinus bulleri. Gray-backed Shearwater. Finding this species in the western North Pacific where it had never before been known was entirely unexpected. The two we collected on July 9 as we entered the edge of the warm current 240 miles southwest of Eterofu were apparently not stragglers, for we observed in all that day 17 individuals flying by, singly or in scattered groups of 2 or 3. The air temperature ranged from 18.5° to 22.5° and the water from 14.5° to 16°. We saw no more when we entered cooler waters the next day.

The Gray-backed Shearwater is very slender bodied, and its neck is relatively long. Its flight is extremely light. When we hove to to haul in a swordfish we had harpooned, several birds wheeled about in the offing as lightly as *C. leucomelas* and with similarly slow wingbeats. Specimens: ♀, July 19, 1954, 41° 10′ N, 149° 57′ E, wt. 342 gm.; ♀, July 9, 1954, 41° 12′ N, 149° 44′ E, wt. 418 gm.

Pterodroma solandri. Solander Petrel. The nearest to the western North Pacific this species had previously been collected was at Borodino Island, east of the Ryukyus. We observed it as follows:

Date	Locality	Temperature °C. Air	Water	Number seen	per hour
July 7	180 mi. SE Shinshiru	12–15	7.5–8	6	1.1
July 8	150 mi. SE Etorofu	7	6.2	1	0.2
July 9	240 mi. SE Etorofu	12–22	12–16	44	5.6

This bird is a large, black, long-winged gadfly petrel somewhat reminiscent of *Puffinus carneipes* at a distance, but at close range its sooty back, short black bill and feet, the whitish undersurface of the wings and the occasional white feathers in front of the eye are distinctive. Its wingbeats are slow, and it soars for good distances low above the calm surface. It occasionally rests on the water. The two collected on July 9 were wheeling over discarded swordfish offal in company with Gray-backed Shearwaters. Specimens: ♀, July 9, 1954, 41° 09′ N, 150° 19′ E, wt. 484.5 gm.; ♀, July 9, 1954, 41° 09′ N, 150° 02′ E, wt. 467 gm.

Pterodroma inexpectata. Peale Gadfly Petrel. This small New Zealand gadfly petrel evidently migrates to the western North Pacific as well as to the Aleutians, where it has been recorded regularly. Unlike the previous two species, it prefers colder surroundings. We found it principally in the cold, rough waters east of southern Kamchatka:

Date	Locality	Temperature °C. Air	Water	Number seen
June 24	100 mi. E Attu	6.2	6.2	1
June 26	200 mi. SSW Commanders	6.5–9	5–6.2	9
June 27	250 mi. SW Commanders	8	5.5	1
July 1	100 mi. E Kamchatka	7	5	2
July 3	150 mi. SW Commanders	6.5	5	5

Most of the birds were seen singly, appearing suddenly soaring on spread wings and sailing quickly out of sight in a wide arc. On June 26 we came upon two birds feeding on a dead pollack in company

with a few Fork-tailed Petrels. While one sat on the water and fed, the other fluttered over it much like a storm petrel. On the wing the black band along the anterior edge of the under wing is clearly observable. The dark breast is characteristic. I collected one: ♀, June 26, 1954, 51° 43′ N, 165° 18′ E, wt. 349.6 gm.

Oceanodroma castro. Madeira Petrel. This is a warm current species, and none intruded into the colder waters. We observed them as follows:

Date	Locality	Temperature °C. Air	Water	Number seen	per hour
June 4	Off northern Honshu	17	13	6	2
July 9	240 mi. SE Kunashiri	17–22	15–16	58	8.3
July 10	150 mi. SSE Kunashiri	18–21	8–12.8	43	8.6
July 13	Off southern Hokkaido	16.5–17	11–12	36	4.5

Oceanodroma leucorhoa leucorhoa. Leach Petrel. We encountered Leach Petrels most abundantly in the waters south of the southern Kuriles. It is a bird of the cold currents, but evidently it prefers slightly warmer waters than does *Oceanodroma furcata*. On the outward voyage I counted 15 per day on June 8, 9, and 10 (2 per hour), and 53 (10 per hour) on the morning of the 11th, north to 47°N, and none the rest of the day. North of this latitude we met the species only sporadically, except southeast of Attu where on June 24 we counted 18 birds (4.1 per hour). The northernmost were 3 birds seen at 55° 56′ N on June 21. East of Kamchatka we saw a few almost daily, ranging from 1 to 7 (0.2 to 1.3 per hour). On the return trip I counted 53 birds again (8.8 per hour) on July 6 in the same area east of Shinshiru. On July 7 the count was 132 (24.9 per hour) in air 13 to 15 degrees, water 6.6 to 8 degrees, on July 8, 27 birds (6.1 per hour) in air 7 to 8.8 degrees, water 6.2 to 7 degrees, and on July 9 only 7 (1 per hour) in air 17 to 22 degrees, water 14 to 16 degrees. But when we crossed the cold current on the 10th the count rose to 24 (4.8 per hour) in air 18 to 21 degrees, water 8 to 12 degrees. The species seems to prefer air temperatures between 13° and 15° and water between 6° and 8°, although we found it in air as low as 4° and as high as 21°, and in waters between 3° and 12.8°. Specimens: ♂, July 1, 1954, 50° 50′ N, 163° 32′ E; ♂, July 9, 1954, 41° 09′ N, 150° 03′ E.

Oceanodroma tristrami. Stejneger Petrel. The only examples of this warm-water species observed were a few off northern Honshu on June 4.

Oceanodroma furcata furcata. Fork-tailed Petrel. This is distinctly a bird of the colder waters. We found it principally where the air ranged from 5° to 12° and the water from 3° to 8°. We saw only scattered individuals in warmer areas. We first met the species south of Urup at latitude 44° 16′ N on June 9. The next day we counted 37 birds (3.7 per hour) southeast of Shinshiru. The next 4 days while we were farthest from land it was much less common, and we saw only 5 birds per day (0.4 to 1.3 per hour). From then on it became more common, averaging 5 to 14 daily (0.6 to 2 per hour) except at our northernmost point in Bering Sea where on June 20 we saw but a single bird. We found it commonest 100 miles east of Kamchatka where several were continually in sight behind the ship, and on June 28 I counted 128 birds (40 per hour). On the southward voyage we again found it concentrated southeast of Urup, and we counted 30 (6.7 per hour) on July 8 just slightly south of where we had first met it on the outward voyage. Specimens: ♂, June 10, 1954, 45° 34′ N, 153° 46′ E, wt. 58.9 gm.; ♀, June 27, 1954, 51° 58′ N, 162° 17′ E; ♀, June 28, 1954, 51° 40′ N, 160° 50′ E; ♀, July 1, 1954, 44° 55′ N, 155° 42′ E.

Oceanodroma furcata, O. leucorhoa, and *O. castro* each uses its wings differently in flight. The species *furcata* characteristically holds its wings bent backward, its fast wingbeats are the shallowest of the three, and it glides frequently. The species *leucorhoa* has longer wings than *castro* and thus looks larger; it flies with a slow, rhythmic, tern-like wingbeat and has the deepest stroke of the three. *Oceanodroma castro* flaps its shorter wings faster and not as rhythmically as does *leucorhoa*.

Phalaropus fulicarius. Gray Phalarope. This species is more pelagic and usually less plentiful off Japan than the following species. I saw two 150 miles south-southwest of Bering Island on July 3. The only others were five seen off the coast of Honshu on July 14, of which I collected a female, 17.5 miles east-northeast of Miyako.

Lobipes lobatus. Northern Phalarope. This species is abundant along the coast of northern Japan in May. The only ones we saw were 1 off Kushiro on June 4, and 5 off northern Honshu on July 14.

Catharacta skua. Great Skua. I saw 2 of these birds on July 9, and 1 on July 13, 50 miles off Cape Erimo, Hokkaido. I was unable to collect any of them, but the latter bird was very dark, similar

to one I collected off Hokkaido on May 31, 1951. Dr. R. C. Murphy examined this specimen when he visited Japan in November, 1953, and agrees with me that it is not *maccormickii*, to which all other Japanese specimens (about 40) are referable. The bird is uniformly deep, dark umber brown from head to underparts, darkening to almost black on the back. A few thin golden shafts are present on the nape, and the exposed white patch of the primaries does not exceed 20 millimeters on the undersurface of the quills. It is rather small in size: wing, 374; tail, 144; culmen, 47; tarsus, 61.5 mm.

Stercorarius pomarinus. Pomarine Jaeger. Specimen: ♂, July 2, 1954, 52° 32′ N, 163° 49′ E. This species was observed as follows:

Date	Locality	Temperature °C. Air	Water	Number seen
June 7	50 mi. E Kushiro	7.6–9	6–6.5	10
June 24	100 mi. E Attu	6	6	1
June 25	200 mi. E Attu	7–9	7	1
June 26	200 mi. SSW Commanders	9	5	1
June 27	250 mi. SW Commanders	6.7	5.5	1
June 28	150 mi. E s. Kamchatka	7	6	2
July 2	200 mi. E s. Kamchatka	10.2	5.2	2
July 3	150 mi. SW Commanders	7	5.3	1
July 4	200 mi. E s. Kamchatka	6	5	1
July 5	180 mi. ESE Paramushiru	7.5	6	1
July 9	240 mi. ESE Kunashiri	17	15.6	1

Stercorarius longicaudus. Long-tailed Jaeger. This species was much commoner than the preceding, as the records show. All but one of the birds observed were young, with the central tail feathers as short or shorter than those of *S. parasiticus*. The records are all assigned to *longicaudus* on the basis of the specimens collected, all of which are this species. It is indeed strange that no *parasiticus* was identified positively; this also has been my experience on other voyages off the Japanese coast.

The Long-tailed Jaeger is apparently the most pelagic of the three species in the genus. Most of the birds seen were solitary individuals. Once two birds chased each other until one vomited a fish, which the other caught in the air. They were seen occasionally chasing Red-legged Kittiwakes and sometimes attacking swimming Slender-billed Shearwaters. The records:

Date	Locality	Temperature °C. Air	Water	Number seen
June 16	100 mi. SW Attu	8	5	1
June 19	250 mi. E Commanders	6.5	5	1
June 20	250 mi. NE Commanders	6.8	5	1
June 22	50 mi. E Commanders	9	6	1
June 23	20 mi. SW Attu	8.8	6	1
June 24	100 mi. W Attu	8	6.5	1
June 27	240 mi. SW Commanders	6.7	5.8	2
July 1	250 mi. E Paramushiru	8	5	1
July 2	200 mi. E s. Kamchatka	7–9	5	4
July 3	150 mi. SW Commanders	7	5–5.3	2
July 4	200 mi. E Shimushu	6–7	5	8
July 5	180 mi. ESE Paramushiru	8	5.5	1
July 9	240 mi. ESE Kunashiri	20–22	15.3–15.5	2
July 13	50 mi. SW Kushiro	14.8	9	2

The birds seen on July 9 and 13 were young of the previous year, probably late migrants passing through these warm seas. Specimens, all immatures: ♂, June 16, 1954, 52° 19′ N, 170° 34′ E, wt. 285 gm.; ♂, June 24, 1954, 52° 24′ N, 170° 14′ E, wt. 269 gm.; ♀, July 2, 1954, 52° 54′ N, 163° 50′ E; ♀, July 3, 1954, 52° 41′ N, 164° 57′ E, wt. 304 gm.

Larus crassirostris. Japanese Gull. Seen only within 20 miles of the Honshu coast; the few observed were scattered, probably nonbreeding individuals.

Larus canus. Mew Gull. A few in immature plumage in Kushiro harbor were the only ones seen.

Larus schistisagus. Slaty-backed Gull. This gull breeds on Daikokujima off Akkeshi, Hokkaido, and was common in Kushiro harbor. None was encountered offshore.

Larus glaucescens. Glaucous-winged Gull. This large northern gull was encountered only in Attu, at the Commander Islands, and in Kamchatka waters. Its comparative rarity is probably attributable to the breeding season. It flies with slow wingbeats, and its wings look proportionately longer than those of the Herring Gull, which in turn has longer wings in proportion to body size than either the Slaty-backed or Glaucous gulls. Specimen: ♀ im., June 17, 1954, 52° 07′ N, 175° 50′ E. The records:

Date	Locality	Temperature °C. Air	Water	Number seen
June 17	20 mi. SE Agattu	7	5	1 im., 2 ad.
June 22	50 mi. E Commanders	8	6	1 im., 6 ad.
June 23	20 mi. SW Attu	8.8	6	3 ad.
July 2	200 mi. E s. Kamchatka	8.5	5	2 im.

Rissa tridactyla pollicaris. Common Kittiwake. This pelagic gull is doubtless much more plentiful at sea in the nonbreeding season than we found it during the voyage. It was commonest when the air temperature was between 7° and 13.5° and the water between 5° and 6°. Specimens: 2 ♂♂, June 17, 1954, 52° 07′ N, 173° 50′ E, wt. 513, 422 gm.; ♀, June 20, 1954, 57° 10′ N, 174° 32′ E, wt. 494 gm.

Date	Locality	Temperature °C. Air	Water	Number seen	per hour
June 10	100 mi. SE Shinshiru	7–13.5	3–3.5	9	1.2
June 16	180 mi. WSW Attu	8–10.1	3.8–5	8	0.8
June 17	20 mi. S Agattu	7	5.1	3	0.4
June 18	50 mi. NE Agattu	8	5.3	1	0.1
June 20	50 mi. NE Commanders	6.8	5	2	0.2
June 23	20 mi. SW Attu	9	5.8	5	0.6
June 24	100 mi. W Agattu	6	6	2	0.5
June 25	220 mi. S Commanders	7–9	6.2–6.9	15	2.1
June 27	240 mi. SW Commanders	8	5.4–6.2	3	0.6
June 28	100 mi. E s. Kamchatka	7	6	3	0.9
July 2	200 mi. SW Commanders	7–8.5	5	1	0.2
July 3	150 mi. SW Commanders	7	5–5.6	13	2.0
July 5	200 mi. E Paramushiru	11.5	5.2–5.6	1	0.2

Rissa brevirostris. Red-legged Kittiwake. In addition to its smaller size, this species can be told in the field from the preceding species by its darker back, by its shorter bill which is slightly greenish yellow rather than chrome, and particularly by its blood-red feet (vermilion in immature birds) with jet black claws. The immature birds have dark spots behind the eye and dark feathers along the edge of the wing but lack the black tip of the tail present in *tridactyla*. It is rather commoner than the Kittiwake in northern waters, but both were observed together on many occasions, often following our ship in company with Fulmars. Specimens: ♂, June 20, 1954, 57° 10′ N, 174° 32′ E, wt. 429.4 gm.; ♀, June 20, 1954, 57° 22′ N, 174° 45′ E, wt. 399 gm.; ♀, June 20, 1954, 57° 28′ N, 174° 52′ E, wt. 410.4 gm.; 2 ♂♂, June 25, 1954, 52° 52′ N, 167° 48′ E, wt. 463.6 gm. (1 bird); ♀, June 25, 1954, 52° 52′ N, 166° 47′ E.

Date	Locality	Temperature °C. Air	Water	Number seen	per hour
June 20	250 mi. NE Commanders	6.8	5	4	0.4
June 21	200 mi. E Commanders	6–7.5	5.2–5.5	5	1.2
June 22	50 mi. E Commanders	9	6	1	0.1
June 25	120 mi. E Commanders	7–9	6.2–6.9	19	2.7
June 27	240 mi. SW Commanders	6–9.2	5.4–6.2	9	1.7
June 28	100 mi. E Kamchatka	7	6	1	0.3
June 29	100 mi. E Paramushiru	11	6.8	1	0.3
July 2	200 mi. E s. Kamchatka	7–8.5	5	10	2.0
July 3	150 mi. SW Commanders	7	5–5.6	42	6.6
July 4	200 mi. E Shimushu	5.5–7	4.8–5.5	21	4.9
July 5	200 mi. E Paramushiru	11.5	5.2–5.6	10	2.0

Sterna hirundo longipennis. Common Tern. Specimen: ♀, July 3, 1954, 52° 57′ N, 164° 40′ E. Single birds were seen as follows:

Date	Locality	Temperature °C. Air	Water
June 14	270 mi. E Paramushiru	7	3.7
June 17	20 mi. SE Agattu	8.5	5
June 22	80 mi. E Commanders	8.5	6
June 24	100 mi. W Attu	7	6.2
June 25	220 mi. S Commanders	9.5	6.5
July 3	150 mi. SW Commanders	6	5

Uria lomvia arra. Thick-billed Murre. Murres were recorded on 19 of our 34 days of voyaging north of Kushiro. They were always seen singly, more often on the wing than swimming, and they were probably all nonbreeding individuals. They were rather rare off the Kuriles, but commoner in Agattu-Kiska Strait and east of Kamchatka. Numbers seen daily ranged from 1 or 2 (0.1 to 0.3 per hour) where they were rare, to 4 to 7 (0.6 to 2.2 per hour) where they were commonest. The northernmost records were single birds seen on June 19 and 21 at latitude 55° N. Air temperatures where they were observed ranged from 5° to 13°, water temperatures from 2.7° to 8.5°. Specimen: ♀, June 14, 1954, 49° 08′ N, 163° 10′ E.

Uria aalge. Common Murre. Most of the murres observed and the one collected were of the preceding species. The only Common Murres identified with certainty were four seen on July 3 southwest of the Commander Islands.

Brachyramphus marmoratus. Marbled Murrelet. This species was seen only near shore in the Kushiro area, 2 on June 5, and 6 on June 7, in air temperatures of 7.5° to 9°, water from 6° to 6.5°.

Synthliboramphus antiquus. Ancient Murrelet. This species was seen only twice: 4 birds east of Agattu on June 18, air 7°, water 4.5°; 2 birds east of the Commanders June 21, air 6.5°, water 5.5°. Specimen: ♂, June 21, 1954, 55° 10′ N, 172° 52′ E, wt. 235.6 gm.

Synthliboramphus wumisuzume. Japanese Murrelet. The movements of this species away from its breeding grounds in the Izu Islands are little known. Evidently some of them move northeastward along the Japanese coast along the edge of the warm current and into the milder cold current. Specimen: ♀, July 10, 1954, 41° 51′ N, 147° 22′ E, wt. 197.6 gm. We observed them as follows:

Date	Locality	Temperature °C. Air	Water	Number seen
July 9	240 mi. SE Etorofu	22.5	15.5	2
July 10	150 mi. ESE Kushiro	21	9	2
July 14	Off northern Honshu	17–22	12.5	4

Cyclorrhynchus psittacula. Paroquet Auklet. This species was observed fairly commonly in Aleutian waters, and a few were seen off southern Kamchatka. It is difficult to identify with certainty at a distance, and a number of tentative records in both these localities are omitted. Specimen: ♀, June 23, 1954, 52° 43′ N, 172° 12′ E. Iris white; bill orange-red, reddish at base, dark red at nares, white at edge of mouth of upper mandible and basal edge of under mandible; feet pale blue.

Date	Locality	Temperature °C. Air	Water	Number seen
June 18	Agattu-Kiska Strait	7	4.5	5
June 23	18 mi. S Attu	9.5	6	30
June 25	120 mi. S Commanders	8.7	6.2	4
July 2	200 mi. E s. Kamchatka	9	5	2

Aethia cristatella. Crested Auklet. A single bird 100 miles south of Urup on June 9 and 66 seen some 120 miles southeast of Shinshiru on June 10 were the only Crested Auklets encountered on the trip. On June 10 the species was quite common, flying about in small flocks, in singles and pairs, often circling the ship in curiosity. Birds on the water uttered a sharp *kirr kirr* before taking flight. The species' flight is fast and free, and the bird in the air resembles a miniature Tufted Puffin. The gonads of those collected were well developed. Specimens: ♂, June 9, 1954, 44° 19′ N, 150° 15′ E, wt. 266.8 gm.; ♂, June 10, 1954, 45° 32′ N, 153° 40′ E, wt. 326.5 gm.; ♀, June 10, 1954, 45° 32′ N, 153° 40′ E, wt. 282.5 gm.; bill orange, tipped yellow; feet lavender blue, the outer side whitish and webs and back of tarsus black.

Aethia pusilla. Least Auklet. This species was rather rare offshore and was encountered in numbers only east of Agattu. Specimen: ♀, June 18, 1954, 52° 08′ N, 175° 52′ E. Iris white; tip of bill reddish; feet pale blue, webs black.

Date	Locality	Temperature °C. Air	Water	Number seen
June 5	Off Kushiro	13	6.2	1
June 7	Off Kushiro	9	6.5	5
June 9	87 mi. SSE Urup	9	3.7	3
June 18	Agattu-Kiska Strait	6.6–8	5–5.3	68
June 19	250 mi. E Commanders	6.5	5	1

Cerorhinca monocerata. Rhinocerus Auklet. Single birds were seen in Japanese waters on June 4 and 5 and on July 14, in air temperatures of 14° to 20° and water of 12°. It was not met with elsewhere.

Fratercula corniculata. Horned Puffin. Rather rare throughout the voyage. Specimens: ♂, June 23, 1954, 52° 12′ N, 171° 56′ E; ♂, June 25, 1954, 52° 52′ N, 167° 47′ E, wt. 600 gm.

Date	Locality	Temperature °C. Air	Water	Number seen
June 9	100 mi. S Urup	6–9	3–3.7	3
June 22	60 mi. E Commanders	8	6	1
June 23	20 mi. SW Attu	9.5	7	1
June 25	110 mi. S Commanders	9	7	3

Lunda cirrhata. Tufted Puffin. This was the commonest of the alcids met with during the voyage, and it was absent from only three of the daily lists. The usual numbers observed were from 2 to 8 (0.3 to 1.5 per hour). It was most numerous around Attu and off Kamchatka, where between June 27 and July 2 we counted daily from 12 to 22 birds (1.9 to 3.8 per hour). We found it most often in air temperatures from 6° to 10° and in water temperatures from 5° to 7°.

We saw it usually in singles and pairs, flying rather high above the water. Almost every bird came to the ship to investigate it, circling around it several times, often coming close to the mast, then dashing off some distance and frequently returning once or twice. The bird flies free and fast, but when on the water it seems to be very heavy-bodied, and it has trouble taking wing. With its rapidly vibrating wingbeats, and its characteristic red bill and feet and white face, it was soon the most familiar of birds to our crew. Specimens: ♀ ad., June 9, 1954, 44° 17′ N, 150° 50′ E, wt. 817 gm.; ♂ ad., June 11, 1954, 47° 00′ N, 157° 32′ E, wt. 779 gm.; ♀ im., June 12, 1954, 48° 30′ N, 161° 40′ E (flightless); ♀ im., June 16, 1954, 51° 50′ N, 169° 06′ E (flightless); ? im., June 25, 1954, 52° 52′ N, 164° 44′ E (flightless); 2 ♀ ♀ im., July 2, 1954, 51° 52′ N, 163° 42′ E, wt. 722, 672 gm.

The first two birds, taken in early June off the central Kuriles, were adults with beautiful long tufts and fully developed gonads. The female, collected almost 200 miles from land, had a large yolk enveloped with gelatinous albumen at the end of the oviduct, almost ready to be laid. The immatures were flightless young of the previous year, which had molted their wing quills, as this species seems to do far at sea. In all, 24 such flightless birds were seen between June 12 and July 7. The subadults collected in late June and early July off Attu and southern Kamchatka seemed to be older young, for they had barely perceptible short tufts. Their feet were still pale colored on the outer side of the tarsus, and their gonads were very small. In juveniles the feet are ivory yellow and the iris umber brown. In subadults the tarsus is red, but pale orangish on the outer edge.

NON-OCEANIC BIRDS

Colymbus stellatus. Red-throated Loon. A single bird in nonbreeding plumage was seen near Attu on June 17.

Colymbus arcticus. Black-throated Loon. Divers, presumably of this species, were seen migrating on June 4 off the mouth of Ozuchi Bay, northern Honshu, in small groups of 8, 2, 5, and 12 birds each. They flew about 100 meters above the sea and were headed north-northeast. I had watched many of them migrating similarly in April and May, 1951. Some seem to head directly for the Kuriles; others move northward along the Hokkaido coast.

Histrionicus histrionicus. Harlequin Duck. I collected a male in worn plumage on July 1 at 50° 30′ N, 161° 49′ E, about 210 miles east of Paramushiru.

Melanitta nigra. Black Scoter. A flock of 10 birds was seen off Kushiro on July 11.

Phylloscopus borealis examinandus. Arctic Willow Warbler. I collected two females that came aboard the ship on July 1 some 180 miles east of southern Kamchatka and 200 miles southwest of Bering Island. It was foggy, with a gentle northeast breeze at the time.

Locustella ochotensis ochotensis. Island Grasshopper Warbler. A female was collected on the ship on June 29 about 170 miles east of Paramushiru. It came from the north in a weak north wind under cloudy skies.

Anthus spinoletta japonica. Water Pipit. A female was collected on shipboard on June 12 about 250 miles southeast of Paramushiru. The wind was northwesterly at the time, about 2 meters per second, and the sky was cloudy.

SUMMARY

This paper presents ornithological obervations made on a 6000-mile sea voyage from early June to mid-July, 1954, aboard a Japanese fur seal research ship. The vessel sailed northeastward from Hokkaido along the Kuriles to Attu, into the Bering Sea, southwestward past the Commanders and Kamchatka, and back along the Kuriles to Japan.

General oceanic conditions, air and water temperatures, winds, and the general distribution pattern of the seabird populations are described. Correlations between bird distribution and air and water temperatures can be made; species generally fall into cold-water and warm-water groups. A rough estimate of population densities is indicated by the number of individual birds seen per hour of observation. The greatest densities were found in the Attu-Agattu waters and off the Commander Islands.

A total of 37 oceanic and 8 non-oceanic species were recorded, of which 60 birds of 28 species were collected. The most interesting species reported are *Puffinus bulleri*, *Pterodroma solandri*, and *Pterodroma inexpectata*, each of which is recorded for the first time from the western North Pacific.

Yamashina Museum of Birds, Tokyo, Japan, March 1, 1955.

THE INCUBATION PATCH IN TINAMOUS

By ROBERT E. BAILEY

There are still many groups of birds for which there is no recorded information concerning the occurrence and structure of the incubation patch. Many of these groups, such as the tinamous, are distributed in relatively remote areas or at least are not readily accessible to ornithologists in this country. During recent expeditions to the Peruvian Andes, Oliver P. Pearson, Anita K. Pearson, Carl B. Koford, and the late Mary R. Koford, of the Museum of Vertebrate Zoology, Berkeley, made extensive studies of the natural history and breeding behavior of the three species of tinamous inhabiting that region. A record of their observations of one of the three, *Nothoprocta ornata,* has recently been published (Pearson and Pearson, Auk, 72, 1955:113-127). The following description of the incubation patch of *Nothoprocta* was made possible by the kind assistance of the Pearsons and Kofords, who collected the material in connection with their field work and made it available to this author for study.

Material from 27 individuals (16 males and 11 females) was included in the collection. It consisted of small pieces of the abdominal skin fixed in Bouin's fluid, sketches of the abdominal region showing the arrangement of the feather tracts and the extent to which feathers had been lost, photographs, dried skins of the abdominal region, and the field notes of the collectors. The fixed material was embedded in paraffin, sectioned at 8 microns, and stained with iron hematoxylin-aniline blue. The large pieces of abdominal skin were relaxed by soaking them in water in order to permit a study of the arrangement and distribution of the feathers.

The collection included specimens of both sexes for nearly every month of the year. Incubation patches were present on all males during the nesting season (middle of February to middle of April). They were absent on females and on males at other times of the year. The presence of a patch only on the males is in agreement with the generally accepted belief that in the family Tinamidae only the males incubate, an observation confirmed in the case of *Nothoprocta* by Pearson and Pearson (*op. cit.*).

The size, number, and location of the the incubation patches is closely related to the arrangement of the ventral feather tracts and apteria (Bailey, Condor, 54, 1952: 121-136). In the tinamous contour feathers on the ventral surface are concentrated in paired ventral tracts which run from the neck region to the anal circlet. The ventral tracts of *Nothoprocta,* like those of other tinamous, are broad on the anterior fourth of the breast and narrow over the remainder of the breast and on the abdomen. At the junction between the narrow and broad parts, each ventral tract is continuous with a tract that runs posteriorly and laterally across the breast and onto the lateral aspect of the thigh.

Down feathers are present but are confined to the feather tracts; the apteria, therefore, are naked. The ventral apterium is quite narrow on the breast (about 20 mm. wide), but it is somewhat enlarged and circular in shape on the abdomen due to the fact that the ventral feather tracts in this region are concave medially. Paired lateral apteria lie lateral to the ventral tracts. These are less sharply defined than the ventral tracts and possess occasional contour feathers.

One of the primary characteristics of an incubation patch is, of course, the absence of feathers due to a special molt. Usually only down feathers are molted and consequently the patches are confined to the apteria. In some groups, however, the patches are enlarged or united into a single large patch by a loss of contour feathers. In *Notho-*

procta the incubation patch develops primarily in the ventral apterium but spreads over the area covered by the ventral tracts by a loss of the contour and down feathers. This loss of feathers from the tracts is not precipitous, as is true of the loss of the down feathers in most birds, but is gradual, with the bare area being continuously enlarged during the period of incubation. In this latter respect, the incubation patch of the tinamous is

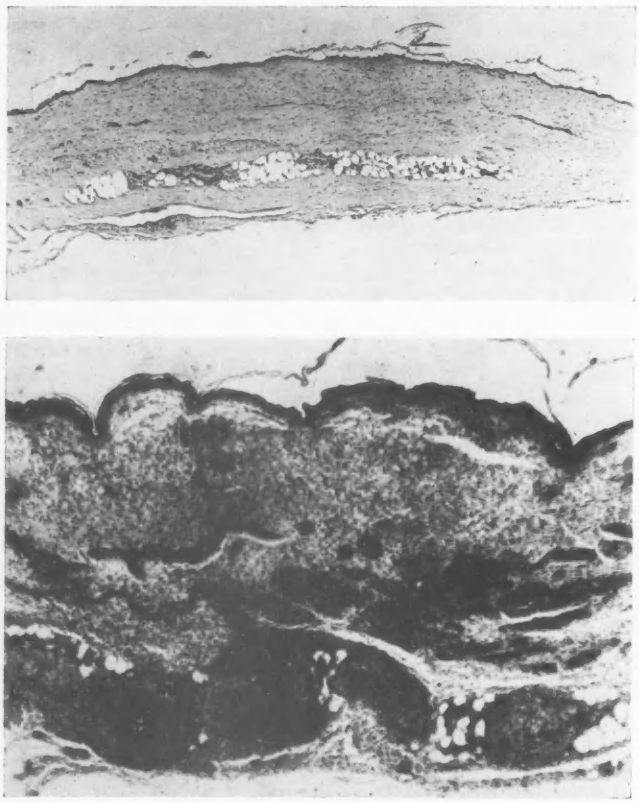

Fig. 1. Skin from the ventral apterium of *Nothoprocta ornata*. Iron hematoxylin —aniline blue; ×62. Above, non-breeding male, August 4. Below, incubating male with incubation patch, April 9.

similar to that of the galliforms, in which there is also a gradual loss of contour feathers which enlarges the median patch and secondarily unites it with the lateral patches.

The fully developed patch of *Nothoprocta* is roughly oval in shape and occupies nearly all the ventral apterium and much of the area of the ventral feather tracts. Because the loss of contour feathers appears to occur in no particular pattern, the edges of the patch are irregular and ill defined. Apparently the patch does not spread to the lateral apteria in *Nothoprocta*. In his field notes, Carl Koford gives the dimensions for

the ventral apterium in a nonbreeding male as 50 by 20 mm. whereas the incubation patch of a breeding male measured 55 by 40 mm.

Feathers are used by the male *Nothoprocta* to cover the eggs while away from the nest (Pearson and Pearson, *op. cit.*). Although it has not been determined which sex builds the nest, it seems probable that the feathers are furnished by the male. There is an increased loss of feathers from the ventral tract as incubation proceeds and at the same time an increase in the number of feathers in the nest.

Figure 1 (above) is a section of the skin of the ventral apterium of a nonbreeding male *Nothoprocta*. It is similar to that of other birds, showing a thin epidermis of a few cell layers and a considerably thicker dermis. The collagenic fibers of the dermis are dense and are arranged parallel to the surface. No large blood vessels are present.

A section of the incubation patch of a breeding male *Nothoprocta* is shown in figure 1 (below). The epidermis and dermis are thicker than in the nonbreeding bird; the dermis is also very edematous. The collagenic fibers are widely separated by tissue fluid and are irregularly arranged. Many large and small blood vessels are present and, as is characteristic of the incubation patch of other birds, there are extensive areas of white-cell infiltration near the vessels.

The present findings constitute the first details available on the incubation patch in the so-called palaeognathous birds (ostriches, rheas, cassowaries, kiwis), with which the tinamous are usually grouped. Davis (Wilson Bull., 57, 1945:189-190) reported the absence of an incubation patch in two female tinamous during the breeding season but apparently no males were collected.

Division of Anatomy, University of Tennessee, Memphis, January 22, 1955.

FROM FIELD AND STUDY

Pygmy Nuthatches Take Arboreal Bath.—At about 9:30 a.m. on January 26, 1941, I noted five Pygmy Nuthatches (*Sitta pygmaea*) frolicking among dripping bough tips 25 feet up in a young Douglas fir (*Pseudotsuga taxifolia*) at Libby, Montana. The tree stood in mixed broadleaf and conifer forest, at this point 20 yards from bordering yellow pines (*Pinus ponderosa*). The excited romping among the needled branchlets was accompanied by an uncommonly large amount of loud, boisterous twittering, which first attracted my attention to them. I observed the nuthatches at this procedure for several more minutes.

A light snow had fallen during the night. The sun now shone through fast-breaking clouds. Temperature in the shade was 40°F. Melting snow on evergreens, larches and deciduous broadleafs hung every branch and needle tip with crystal droplets that sparkled brilliantly in the bright sunshine. The spirited clambering of the birds among the dripping boughs appeared to be a very wet activity. The nuthatches seemingly sought the wettest needle tufts of the heavily foliaged fir. I had never seen this species bathing at a stream or pool. But here without doubt they were engaged in taking a mid-winter "fir-needle bath."

All the nuthatches had well dampened plumage. They would shake their feathers violently, then plunge again into the soaking branchlets. One or two shook themselves quite dry and flew on ahead. —JOHN L. BLACKFORD, *Libby, Montana, May 2, 1955.*

An Apparent Hybrid between the Ring-necked Pheasant and the Blue Grouse.—In July of 1951 a male gallinaceous bird, apparently a hybrid between a Ring-necked Pheasant (*Phasianus colchicus*) and a Blue Grouse (*Dendragapus obscurus*), was sent to the Conner Museum at Washington State College by Mr. William W. Wadkins of the Spokane Game Farm, Deer Park, Spokane County, Washington. This bird appeared outside the cages at the game farm in January, 1948. It was captured and kept in an enclosure for about three and a half years until it died in July, 1951. According to Mr. Wadkins this bird showed no indication of sexual activity.

When this specimen was delivered to me, it was considerably decomposed. It was preserved as a flat skin and skeleton (weight 1144 gms., length 596 mm., extent 766 mm., tail 185 mm.). The lateral rectrices are about two inches shorter than the central ones, giving the tail a wedge-shaped appearance.

Features resembling the Ring-necked Pheasant were: some bare red skin on sides of face; bright reddish-brown edgings to some feathers of the neck, breast, flanks and under tail coverts; buffy-white barring and freckling of primaries and secondaries; grayish-buff barring and freckling of basal two-thirds of rectrices; tarsi scutellate on about the distal two-fifths and behind; presence of adductor digiti II muscle in the foot.

Features resembling the Blue Grouse: throat buffy freckled with black; tail black distally; dorsum barred much as in a female Blue Grouse; tarsi feathered on basal three-fifths anteriorly; no tarsal spurs; tail rather short.

Jewett (Condor, 34, 1932:191) has recorded four hybrid specimens involving the Ring-necked Pheasant and Blue Grouse.—GEORGE E. HUDSON, *Department of Zoology, State College of Washington, Pullman, Washington, May 4, 1955.*

Old-squaw Duck at Lake Tahoe, California.—Grinnell and Miller (Pac. Coast Avif. No. 27, 1944:86–87) give the status of the Old-squaw Duck (*Clangula hyemalis*) in California as "Midwinter visitant, mostly November to January; . . . 'rare'." No record is given of its occurrence in interior California. However, Marshall and Alcorn (Condor, 54, 1952:321) give recent records of the Old-squaw Duck for western Nevada.

On the surprisingly late date of May 16, 1955, a male Old-squaw Duck was observed near the mouth of the Upper Truckee River at the south shore of Lake Tahoe in Eldorado County, California. The bird, when first observed, was alone on open water in a deep part of the channel that meanders through the marshlands near the lakeshore. As I attempted to move closer, it flushed, made a take-off

run of about 30 feet, and left the area, heading north across the lake. The bird appeared to be in a healthy condition; it was in first-year or immature plumage.—FRED G. EVENDEN, *California Junior Museum, Sacramento, California, May 27, 1955.*

The Taxonomic Status of the Maroon-fronted Parrot.—The Maroon-fronted Parrot (*Rhynchopsitta terrisi*) was described by Moore (Proc. Biol. Soc. Wash., 1947, 60:27–28) from the Sierra Madre Oriental (mistakenly published as Occidental) in west-central Nuevo León, México. A related species, the Thick-billed Parrot (*Rhynchopsitta pachyrhyncha*) ranges widely in México in the Sierra Madre Occidental.

Rollin H. Baker, J. Sheldon Carey, and Robert W. Dickerman of the University of Kansas recently collected five parrots (KU 31530–31534) in Coahuila which, judging only by published descriptions, seemed to be intermediate between the two species. The localities of collection of these five specimens are as follows: four birds from 13 miles east of San Antonio de las Alazanas, Coahuila; one specimen from the Mesa de las Tablas, Coahuila. Three of the Coahuilan birds were sent to Dr. Robert T. Moore for comparison with the four known specimens of *R. terrisi*. Our birds were compared also with 15 specimens of *R. pachyrhyncha* made available by the University of Michigan Museum of Zoology and the United States National Museum.

Upon examination of the Coahuilan specimens and comparison of them with *terrisi*, Dr. Moore concluded that our birds are typical *R. terrisi*. Since, in our judgment, the Coahuilan birds did not agree with the published description of *terrisi*, the following analysis of similarities and differences between *pachyrhyncha* and *terrisi* seems desirable.

Measurements	*pachyrhyncha*		*terrisi* (Coahuilan series)		*terrisi* (type series)	
	♂	♀	♂	♀	♂	♀
Wing mean (no.)	262.0 (8)	253.3 (6)	275.1 (3)	282.5 (1)	288.8 (3)	283.4 (1)
range	258.5–270.0	248.5–264.5	260.5–285.5			
Tail mean (no.)	177.6 (8)	171.7 (6)	192.7 (3)	181.9 (1)	190.5 (3)	189.1 (1)
range	172.5–186.5	159.0–179.5	172.1–207.1			
Exposed culmen mean (no.)	39.7 (8)	38.4 (6)	41.2 (3)	40.0 (1)	42.0 (3)	41.0 (1)
range	39.0–40.5	37.0–39.5	40.2–43.0			
Tarsus mean (no.)	20.4 (8)	20.3 (6)	21.7 (3)	21.5 (1)	23.6 (3)	22.6 (1)
range	18.5–21.5	19.5–21.0	21.0–22.2			

According to the original description of *terrisi*, this species differs from *pachyrhyncha* in having "the entire green of upper parts and under parts very much darker, about Cosse Green." Upon re-examination of the type series, Moore (letter to Hardy, February 3, 1955) wrote: "Upper parts: In our specimens coloration exceedingly variable, depending on whether the feathers are badly worn or freshly molted.—Oil Green [bright] on the former, Cosse Green [dark] on latter." He further indicates that the color of the underparts varies with wear, but in the fresh-plumaged birds these areas are lighter green, the worn ones darker. Our Coahuilan birds are in fresh plumage and are bright green as in *pachyrhyncha*. It seems to us that the supposed difference in green coloration between the species is mostly dependent on wear and may not be of taxonomic value in separating the two forms.

The color of the anterior lesser wing coverts in *pachyrhyncha* is bright red, in *terrisi* (Moore's specimens) dark red. This is given in the published description of the latter as a distinguishing character, although Moore points out in his letter that in his *R. terrisi* these feathers are worn. In our Coahuilan birds which Moore assigns to *R. terrisi* these unworn coverts are bright red as in *R. pachyrhyncha*.

The feathers of the carpometacarpal region in *R. pachyrhyncha* are highly variable in color. They are sometimes bright red in both wings, red on one and brown on the other, or brown on both wings. According to the original description the color of this area in *terrisi* is reddish-brown, with no mention of variation. After comparing his specimens with the Coahuilan birds Moore states: "Coloration exceedingly variable in our specimens, even on the same individual. On three of our specimens this character averages very dark, except for an occasional freshly molted feather, which is much brighter and definitely red. On the type new feathers predominate in this area and are as brightly red as on your birds." The Coahuilan birds show various combinations of red and brown feathers on this area.

The color of the forehead of *R. pachyrhyncha* is bright red flecked with maroon. The preorbital space is maroon or brown. In *R. terrisi* (type series) the forehead and preorbital space are maroon. Our Coahuilan specimens have the forehead and preorbital space maroon, but some specimens show flecks of bright red, usually on single, unworn feathers.

The under primary coverts of *R. pachyrhyncha* exhibit a definite patch of bright yellow. While no definite yellow patch exists in either Moore's *R. terrisi* or the Coahuilan birds, there is an olive-yellow wash present in this region.

The Coahuilan specimens lack the distinctly bluish-green cast of the cheeks which is characteristic of *R. pachyrhyncha*. This character is not mentioned in the original description of *R. terrisi*.

R. pachyrhyncha is considerably smaller than *R. terrisi*. Our Coahuilan birds are slightly smaller than *R. terrisi* in most measurements but perhaps not significantly so.

We think that uniting *R. terrisi* and *R. pachyrhyncha* as a single species better expresses the relationship of these well marked forms, which should, therefore, be called *Rhynchopsitta pachyrhyncha pachyrhyncha* (Swainson) and *Rhynchopsitta pachyrhyncha terrisi* Moore. We assign our Coahuilan specimens to *R. p. terrisi*.

We are grateful to Dr. Robert T. Moore and Mr. Donald Medina of the Moore Zoological Laboratory at Occidental College for carefully comparing our specimens with the type series of *R. p. terrisi*, and to Dr. J. Van Tyne of the University of Michigan Museum of Zoology and Dr. Herbert Friedmann of the United States National Museum for lending us specimens of *R. p. pachyrhyncha*.—JOHN WILLIAM HARDY and ROBERT W. DICKERMAN, *Museum of Natural History, University of Kansas, Lawrence, Kansas, March 14, 1955.*

The Breeding Range of the Black Rosy Finch.—The Black Rosy Finch (*Leucosticte atrata*) has been known to have a fairly limited and well defined range in the high mountains of central Idaho, southwestern Montana, western Wyoming, and northern Utah. Across intervening gaps in mountain habitat it is replaced to the west and east by strikingly different forms. *Leucosticte tephrocotis wallowa* occurs in the mountains of eastern Oregon and *Leucosticte australis* in the Rocky Mountains of southeastern Wyoming and eastern Colorado. *L. atrata* has some contact with *L. t. tephrocotis* to the north, but the nature of this meeting is as yet undetermined; at least occasional interbreeding may occur in the Bitterroot Mountains of western Montana (Mewaldt, Condor, 52, 1950:239).

A major extension of known breeding range of *Leucosticte atrata* was recorded in June of 1955 while collecting in the Jarbidge Mountains of northern Elko County, Nevada. Here on June 23, on Jarbidge Peak, six breeding individuals were taken in alpine cirques between 10,000 and 10,700 feet. The rosy finches were associated in pairs and the males were singing. The females had not yet laid, but enlarged ova up to 2½ mm. in diameter were present and laying would have occurred soon. Two females accompanied by males made several trips between a patch of sedge along a stream flowing from beneath a snow field and north-facing cliffs above, apparently occupied with gathering nest material. Males had testes measuring 10 and 11 mm. in length.

The birds from the Jarbidge Mountains differ in no way from a series of *atrata* taken near Cooke, Park County, Montana. The Jarbidge Mountains lie about 130 miles south of the Sawtooth Mountains of Idaho across the Snake River basin. The Sawtooth area is the closest point in the previously known breeding range of *atrata*. Farther away, across the Salt Lake basin, *atrata* breeds in the Wasatch Mountains of Utah. Heretofore no member of the genus *Leucosticte* has been found breeding in Nevada. The occurrence of rosy finches in the Jarbidge Mountains lends credence to a sight

record of leucostictes for late June in the Deep Creek Mountains of extreme western Utah and makes it seem probable that the form involved there was likewise *atrata*.—ALDEN H. MILLER, *Museum of Vertebrate Zoology, Berkeley, California, July 14, 1955.*

Nesting of the Western Tanager in the Santa Cruz Mountains, California.—The Western Tanager (*Piranga ludoviciana*) was listed as an uncommon and irregular summer resident in the Santa Cruz area of California by McGregor (Pac. Coast Avif. No. 2, 1901:16) but no nests were known to him. Although singing males and young birds have been reported subsequently (see, for example, Allen, Gull, 11(6), 1929:2), no nests were recorded until recently.

On May 19, 1951, Mrs. M. E. Shore found a nest under construction seven miles south of Los Gatos in the Santa Cruz Mountains. The present writer discovered a nest containing large nestlings on Stevens Creek, 12 miles west-southwest of San Jose on June 7, 1951. The nest was placed on a horizontal branch, 15 feet from the ground in a coast live oak (*Quercus agrifolia*). The nestlings were being fed by both parents on June 7 and 8. On June 9 the nest was empty and there was no evidence of either young or adults in the vicinity. At this same locality a nest was found on May 17, 1952, placed on a coast live oak branch, 30 feet from the ground. The behavior of the birds indicated that incubation was in progress.

Miss Emily D. Smith found a nest under construction two miles northwest of Los Gatos on June 17, 1951. On July 14 nestlings were being fed in this nest which also was placed on a horizontal coast live oak branch. On June 8, 1952, the writer was shown a tanager nest on the property of Miss Gladys Record in Los Gatos. The nest, which contained eggs or possibly small young, was in a coast live oak.

At the present time the status of the Western Tanager in the Santa Cruz Mountains seems to be that of a fairly common summer resident. It nests rarely in the Diablo Range (Mount Hamilton) on the east side of the Santa Clara Valley and in Marin County, but certainly not as abundantly as in the Santa Cruz Range.—CHARLES G. SIBLEY, *Department of Conservation, Cornell University, Ithaca, New York, March 7, 1955.*

Additional Records of "Tule Geese" from Solano County, California.—Ever since Swarth and Bryant (Univ. Calif. Publ. Zool., 17, 1917:209–22) established the systematic status of the so-called "Tule Goose" (*Anser albifrons gambelli*) as a race of the White-fronted Goose, it has remained a rather obscure entity. It apparently has a limited distribution on both its wintering and breeding grounds. The characters which distinguish this race from *A. a. albifrons* as well as its distinctive habits have been adequately described by Swarth and Bryant, Bailey (Condor, 30, 1928:164–165), Moffitt (Condor, 28, 1926:241–243; 40, 1938:76–84) and Kortright (The Ducks, Geese and Swans of North America, 1942). These authors cite wintering records from only the Butte and Sutter basins in the Sacramento Valley and from the Suisun marshes of California. The breeding grounds of *gambelli* were not located until 1941 when breeding birds were found on the Perry River in the Canadian Arctic (Gavin, Wilson Bull., 59, 1947:195–203).

On December 21, 1954, I collected two *gambelli* from a flock of eight that was inhabiting a small area on the southern part of Banty Island in the marshes of the lower Napa River, Solano County, California. Two more were taken on December 24 and the remaining four were seen again on December 26 and January 2, 1955, at the same locality. This island is a part of the public hunting area owned by the Leslie Salt Company. Within the past year the company had constructed a peripheral levee around the island that held the water in its numerous small sloughs at approximately high-tide level. This situation may have contributed to the establishment of the particular sort of habitat favored by these geese, since in twenty-five years' experience hunting this area, none of this race had been previously observed. The sloughs were bordered by a dense complex of *Scirpus, Typha,* and *Spartina,* with interstitial areas supporting growths of *Salicornia* and *Grindelia.*

As in the observations reported by the authors cited, this flock of *gambelli* remained separate from the several flocks of *A. a. albifrons* feeding on sprouting grain fields in the vicinity. In so far as was observed, the "Tule Geese" were feeding primarily on the tubers and rhizomes of *Scirpus* which

they pulled up from the mud beneath water that was as much as one and one-half feet in depth. At one spot almost all the rushes over an area of approximately one hundred and fifty square feet had been uprooted.

The proventriculi and gizzards from the two specimens collected on December 24 were kindly analyzed by Mr. Howard Leach of the Department of Fish and Game Food Habits Laboratory as follows: (1) 20 *Scirpus robustus* (tuber and rhizome fragments), 25.0 cc.; forb (leafage), trace. (2) 5 *Scirpus robustus* (tuber and rhizome fragments), 9.0 cc.; insects (fragments), trace.

All four specimens were males, three adult and one immature. The three adults weighed 6 lbs. 14 ozs., 6 lbs. 8 ozs., and 5 lbs. 8 ozs. None possessed any reserves of fat. Two of the skins were placed in the Museum of Vertebrate Zoology, Berkeley, and one each in the teaching collections of the Departments of Zoology of the University of California at Berkeley and Davis.

I wish to express appreciation to Dr. Alden H. Miller for identification of these specimens.—
WILLIAM M. LONGHURST, *Hopland Field Station, University of California, Hopland, California, April 1, 1955.*

Influence of Winter High Tides on Two Populations of Salt Marsh Song Sparrows.—In a recent paper Sibley (Condor, 57, 1955:241–242) gave observations on occurrence and behavior of birds and mammals of the salt marshes near Alviso, Santa Clara County, California, during the diurnal high tides that occur there annually from November to January. Concerning Song Sparrows (*Melospiza melodia*) his data are of critical interest to students of population dynamics and evolution. He relates that in walking into the marsh on a levee he met a flock of about 100 small land birds concentrated on it. Approximately 75 per cent of this flock was Song Sparrows; this is about 75 individuals, the number that could be drawn from about 35 to 40 acres of salt marsh in the breeding season (Johnston, Audubon Field Notes, 6, 1952:316–317). Apparently these birds had moved out of their winter territories to congregate on high ground and escape the tidewater.

My observations of color-banded Song Sparrows on the San Pablo salt marsh, Richmond, Contra Costa County, California, during similar high tides are different. I was in the field five days in 1950 and 1951 when tides of 6.9 to 7.4 feet inundated the marsh. San Pablo salt marsh is relatively undisturbed and there are no major man-made ecologic features extant, such as levees, dikes, and drainage cuts. But, during the winter high tides much floating debris is brought onto the marsh by the tidewater; some of this is substantial planks and timbers. It is on such debris and in the emergent vegetation (mainly *Grindelia cuneifolia*) that Song Sparrows of San Pablo marsh move to escape high tidewater. Such movement is almost always accomplished within the winter territory, or domicile. I recorded one instance of a banded Song Sparrow out of its winter territory by some 150 yards. As I watched this bird another Song Sparrow flew at it aggressively and there ensued a typical melospizine squabble that ended with the banded individual returning approximately to his domicile. This was the only bird I saw that had moved more than 10 to 20 yards during a high tide.

Adult Song Sparrows on San Pablo marsh remain for life in or extremely near the territory they take up in the fall of their first year of life (Johnston, MS); presumably the Song Sparrows of the southern San Francisco Bay marshes are likewise restricted in movement, although there is no evidence of this beyond the fact of a fairly high degree of differentiation from other populations of Song Sparrows in the uplands surrounding the bay marshes. Therefore, the concentrations mentioned by Sibley imply movements that are probably departures from the usual behavior of Song Sparrows, influenced in large part by the existence of the man-made levee.

There are two possible effects of large-scale movements caused by the high tides that occur ten or twelve times each winter. First, the movement made by the birds necessary to reach high ground at the levee may influence the typically sedentary nature of Song Sparrows on the Alviso marshes. Thus, population structure may be affected by accelerated exchange of individuals from remote parts of the population. Panmixia would be favored and the small, intrapopulation breeding aggregates (Mil'er, Evolution, 1, 1947:186–190) would tend to disappear. Second, there is little doubt that the age structure of the population is changed by increased losses to predators during the high tides. Along the same levee that contained the high number of Song Sparrows, in a distance of two miles, Sibley counted ten Short-eared Owls (*Asio flammeus*) hunting the rich prey source. There is no evidence of a differential survival due to age in the Song Sparrows, but such a hunting pressure on a concentrated

fraction of the salt marsh population would change the mortality relationships under which the population had evolved, at the same time changing the distribution of age classes within it.—RICHARD F. JOHNSTON, *Museum of Vertebrate Zoology, Berkeley, California, July 31, 1955.*

Cedar Waxwings Occupy Old Nest of Western Tanager.—*Bent (U. S. Nat. Mus. Bull. 197, 1950:83) quotes Ford in respect to the habit of the Cedar Waxwing (Bombycilla cedrorum) of taking material from active nests of other species of birds for use in its own nest. No mention is made of* utilization of nests, old or new, of other birds for its nest site.

Fig. 1. Male and female Cedar Waxwing with nestlings in Douglas fir, July 27, 1954, at Libby, Montana. This is not the rebuilt nest described in the text but another nest likewise composed chiefly of "deer moss," together with grass blades and a few twigs. Nest lowered 3 feet from original site which was 6 feet above ground. Photograph by J. L. Blackford.

On June 23, 1945, I watched Cedar Waxwings rebuilding a year-old nest of the Western Tanager (*Piranga ludoviciana*) in which a pair of the latter species had reared a brood the preceding season. From subsequent observations, the weathered tanager nest, which now appeared to be composed largely of coarse, interwoven foundation twigs, was employed chiefly as a platform on which a typical waxwing structure was erected. The location was among green branchlets fairly well out toward the end of a slanting bough 35 feet up in a Douglas fir. The tree stood in a small opening in mixed broadleaf and conifer forest 2 miles north of Libby, Montana. A conspicuous feature of the completed nest was the plentiful use of the black "deer moss" (*Alectoria*). On July 21, 1945, I recorded the waxwing pair as having large young in the rebuilt nest.—JOHN L. BLACKFORD, *Libby, Montana, February 24, 1955.*

Night Migration of the Scissor-tailed Flycatcher.—Those who have observed night bird migration through a telescope as the birds pass between the earth and the moon know that it is virtually impossible to identify species, although size, shape, numbers or formation will sometimes give an indication of the family or order. Normally it only requires a part of a second for a bird to pass across the face of a full or near-full moon. It was quite surprising, therefore, when another observer and I, each looking through a separate telescope, simultaneously exclaimed "Scissor-tail" when a bird passed across the moon's face from north to south. This bird displayed the extremely long, trailing tail and short wings of the Scissor-tail (*Muscivora forficata*). Its identification as this species seems certain because of the lack of a similarly-shaped species with which to confuse it.

This observation occurred on October 2, 1952, at 10:47 p.m. The telescopes were the 10.0-inch reflecting telescope and the 3.5-inch refracting "finding scope" in the University of Oklahoma Observatory, Norman, Oklahoma. I was one of several from the Cleveland County Bird Club who were recording the numbers of night-migrating birds. Two observers were always on duty with a third person who recorded the data as they were called out by the observers.

It is common knowledge that many species of birds migrate at night. I know of no other account of night migration of the Scissor-tail.—Carl D. Riggs, *University of Oklahoma, Norman, Oklahoma, July 15, 1955.*

NOTES AND NEWS

The Cooper Ornithological Society has recently learned that it is a beneficiary in the will of the late Dr. Harry R. Painton. The Society is to receive 20 per cent of the estate which is appraised at approximately $197,000; the money will very importantly augment the endowment reserves of the organization, perpetuating Dr. Painton's deep concern for its welfare and its publication program. Dr. Painton was one of the four founders of the Cooper Ornithological Club in 1893 at San Jose (see Condor, 45, 1943:162, fig. 41). Following a life-time of active service in medicine, he resumed his ornithological interests in 1936. In 1940 and 1941 he served as President of the Northern Division and subsequently was President of the Board of Governors until 1946. He was elected an honorary member in 1947.—A.H.M.

The Twenty-sixth Annual Meeting of the Cooper Ornithological Society in 1956 will be held in Seattle, Washington, in late June at the time of the meetings of the Pacific Division of the American Association for the Advancement of Sciences. Exact dates will be announced later. The Cooper Society meeting is being held in Washington at the invitation of the Pacific Northwest Bird and Mammal Society and the University of Washington. A future annual meeting is contemplated in Salt Lake City at the suggestion of Dr. William H. Behle.

Dr. T. S. Palmer, Honorary Member of the Cooper Ornithological Society and for many years Secretary of the American Ornithologists' Union, died on July 23, 1955, at the age of 87. He had been a member of the Cooper Society since 1904 and was known in the West especially for his participation in the initial biological exploration of the Death Valley area in 1891 as a member of the United States Bureau of Biological Survey.

Readers of this issue of the Condor should realize that the Whooping Cranes involved in the report by Harvey Fisher were anatomical specimens salvaged from birds that were found dead; there was of course *no* collecting of this very rare bird. Ornithologists the world over who are concerned for the preservation of the Whooping Crane will be dismayed to learn of a proposal to establish a bombing practice range next to the Aransas Refuge in Texas where apparently the entire remnant population of the species spends the winter. Should such a development carry through despite protests to government officials, it seems likely that this will mean the end of this magnificent crane.—A.H.M.

PUBLICATIONS REVIEWED

THE WATERFOWL OF THE WORLD. Volume 1. By Jean Delacour with sixteen plates in color by Peter Scott and thirty-three distribution maps. Country Life Limited, London, 284 pp., with frontispiece. September 30, 1954. Price, five guineas.

This is a magnificently prepared and published book constituting part one of a projected three-volume work on the anseriform birds of the world. It is seldom that a reviewer can wholeheartedly agree with advertising statements on the book cover, but one may in this instance subscribe without reservation to the fact that "the author and illustrator . . . are beyond question the two men with most knowledge of waterfowl in the world today . . . . Both have formed world-famous [live] collections of waterfowl—Mr. Delacour at Clères in Normandy before the Second World War, and Mr. Scott at Slimbridge in Gloucestershire since the war ended."

Part one deals with the subfamilies Anseranatinae, Anserinae, and Anatinae, thus including such familiar types as tree ducks, swans, geese, shelducks, and steamer ducks. The classification naturally follows the reclassification of the order Anseriformes of Delacour and Mayr of 1945. There is only one properly called-for alteration that affects the groups here covered, namely the elevation of the Australian Magpie Goose, *Anseranas*, to a division of subfamily rank. In the treatment of groups and species the approach is that of synthesis and summarization in which opinions are expressed without full documentation. Thus the work is not exhaustive, and should critical users be inclined to reexamine the full basis for decisions, they will have to search elsewhere among many uncited items. But of course the experience of the author is such as to guarantee well supported conclusions on most issues.

The treatment includes keys, brief descriptions of species, synopses of habits, distribution, and, most appropriately, matters related to holding waterfowl as captives. Excellent maps are provided and Scott's superb comparative illustra-

tions are an artistic delight as well as useful and accurate guides to identification. Three very informative plates show downy young.

It is no criticism of the present book to remind ornithologists that research on the anseriforms is still a wide open field. For example, a complete analytical comparative anatomy of the order is not available to support or refute the details of Delacour and Mayr's classification. Also, we are only beginning thoroughly to record and catalog behavior of anseriform species and a consolidated comparative behavior of the whole group, with strong phylogenetic implications, may emerge in several decades.—ALDEN H. MILLER.

COOPER SOCIETY MEETINGS

NORTHERN DIVISION

JANUARY.—A special meeting of the Northern Division was held at the University of California on January 27, 1955, in place of the regular February meeting. Mr. Elmer G. Worthley, Bonita Avenue, Owings Mills, Maryland, was proposed for membership by C. V. Duff.

Reports of field observations included the following: Alden H. Miller reported finding the nest and egg of an Anna Hummingbird at Clear Lake on January 22. It was suggested that early breeding of the Anna Hummingbird there is made possible by early blooming of manzanita. Dr. Miller also reported a Tree Swallow present at Clear Lake on January 22. Howard Cogswell stated that a Ross Goose had been seen at the Marina in San Francisco on the day of the Christmas Bird Census in December, 1954.

The speaker of the evening was H. J. Frith of the Australian Wildlife Survey Section, who gave a talk on "Incubation in the Megapodidae."—ROBERT K. SELANDER, *Secretary*.

MARCH.—The monthly meeting of the Northern Division was held on March 3, 1955, at the University of California, Berkeley. The following names were proposed for membership: Mr. Thomas S. Butler, San Clemente Road, El Granada, Calif., proposed by Dr. R. T. Orr; Mrs. Betsey D. Cutler, 2128 Great Highway, San Francisco 16, Calif., proposed by Mrs. J. W. Kelly.

A. L. Curl noted a male European Widgeon at Fleishhacker Zoo in San Francisco on February 19 and Howard Cogswell reported that one, presumably the same individual, was present there on February 27. Mr. Cogswell reviewed George Wallace's new text on ornithology, "An Introduction to Ornithology." A. H. Miller called the attention of members to a recenty published monograph on the Passenger Pigeon by A. W. Schorger.

The speaker of the evening was Dr. Richard E. Genelly, who discussed the "Annual Cycle and Dynamics of a California Quail Population."—ROBERT K. SELANDER, *Secretary*.

APRIL.—The monthly meeting of the Northern Division was held on April 7, 1955, at the University of California, Berkeley. The following names were proposed for membership: Mr. Robert F. Jasse, 3719 Spruce Street, Philadelphia 4, Pa., proposed by R. K. Selander; Mrs. L. N. Feenaty, 510 North Meridian Street, Apartment 101, Indianapolis 4, Ind., and Capt. Albert L. Prosser, Box H, Springvale, Maine, proposed by F. A. Pitelka; Mrs. Freda W. Berwick, Room 548 Mills Lower, 220 Bush Street, San Francisco 4, Calif., Nina Moody, 547 13th Street, Richmond, Calif., Mrs. Beth C. Snyder, 449 Nob Hill Drive, Walnut Creek, Calif., and Mrs. William Greuner, 877 Broadway, Lafayette, Calif., proposed by Mrs. J. W. Kelly.

The speaker of the evening was Dr. Russell L. Congdon, who presented color motion pictures of the birds of the Malheur Refuge, Oregon.—ROBERT K. SELANDER, *Secretary*.

JUNE.—The monthly meeting of the Northern Division was held on June 2, 1955, at the University of California, Berkeley. The members present voted not to hold a regular meeting of the Northern Division in September. The following names were proposed for membership: Mrs. E. S. Gillette, Jr., 3212 Jackson Street, San Francisco 18, Calif., proposed for Sustaining Membership, and Mrs. Ruth B. Robertson, 567 Vistamont Avenue, Berkeley, Calif., proposed by Mrs. J. W. Kelly; Capt. Merle L. Kuns, P.O. Box 192, Ramey Air Force Base, Puerto Rico, proposed by F. A. Pitelka.

The speaker of the evening was Mr. C. G. Willis of Sierra Madre, California, whose illustrated talk was "Following Birds with a Candid Camera."—ROBERT K. SELANDER, *Secretary*.

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr., 161 West 121st St., Los Angeles 61, California.

WANTED—Sutton, The Birds of Pymatuning Swamp and Conneaut Lake; Wilson Bull., vol. 57, no. 1, vol. 58, no. 1, vol. 63, nos. 1–3. Please state price and condition.—JOHNNY WIENS, *428 Chautauqua, Norman, Okla.*

BINOCULAR INFORMATION—Do you know about binoculars especially adapted for birding? Send for details and list of Bausch and Lomb binoculars with quality analysis. Also, free reprints to members of Cooper Ornithological Society of articles "Alignment" and "Know Your Binoculars," originally published in Audubon Magazine. If your binocular is not functioning perfectly, send it to us for a free collimator check and repair estimate. We answer questions personally; write us about your binocular problems.—THE REICHERTS, *Mirakel Repair Co., 14 W. First St., Mount Vernon 15, N.Y.*

FOR SALE—Complete files of Bulletin of the Nuttall Ornithological Club, vols. 1–8, and The Auk, vols. 1–71 (Bull. Nuttall Club and The Auk, vols. 1–18, nicely bound; remainder unbound but in fine condition). Inquiries invited from interested buyers; proceeds to be deposited in the Endowment Fund of the Cooper Ornithological Society.—C. V. DUFF, *Business Manager, C.O.S., 1922 Tamarind Ave., Hollywood 28, Calif.*

FOR SALE—The Species of Middle American Birds, by E. Eisenmann, 128 pp., just published. Lists all species recorded from Mexico to Panama, inclusive, giving technical and English names, outlines of range, and a distributional bibliography of over 200 items; $2.00.—LINNEAN SOCIETY OF NEW YORK, *% American Museum of Natural History, Central Park West at 79th St., New York 24, N.Y.*

WANTED—Scientific study skins of western and North American birds in general for teaching purposes on two new campuses; also, some mounted specimens are desired. Send list of available specimens, or write for our want list.—ROLAND C. ROSS, *Los Angeles State College, 855 N. Vermont Ave., Los Angeles 29, Calif.*

WANTED—Young man interested in BIRDS and PHOTOGRAPHY to learn technical color printing methods under excellent supervision. Full time job in production of photographic prints and other duties to help in producing a book on birds. Extreme interest in and knowledge of birds necessary but actual experience in photography not necessary as long as man wants to learn. Call HOllywood 5-6183, Ext. 1.—BLEITZ WILDLIFE FOUNDATION, *1001 N. McCadden Pl., Los Angeles 38, Calif.*

PREPARATION OF MANUSCRIPTS FOR THE CONDOR

Articles published in the Condor normally are written by members of the Cooper Ornithological Society. Practically all the Society's money goes into the journal; no editor or business manager receives any pay other than the satisfaction of doing a service worthily. The preparation of good copy by the author will contribute greatly to accuracy of published output, dispatch in handling, and economy of production.

To be acceptable for inclusion in the Condor, articles must not duplicate in any substantial way material that is published elsewhere. Any type of subject bearing on birds may be considered; but the geographic areas of primary concern are western North America, Central America, and the Pacific Basin. Manuscripts may be sent to the editors at the Museum of Vertebrate Zoology. Proofs with edited manuscripts will be sent to authors, at which time reprints may be ordered.

In the interests of accuracy and economy, observe the following: do not duplicate data in text, tables, or charts; check citations to original sources and verify text references; quoted statements must be exact replicas of the original; preferably use vernacular names applicable to the entire avian species (for a guide in this regard, see "The Distribution of the Birds of California," Pac. Coast Avif. No. 27, 1944:5-34); in general, avoid subspecific vernaculars; insert scientific names for species but not the subspecific name except in taxonomic papers or where the race concerned has been critically determined by the author or his collaborators; revise the manuscript repeatedly to remove superfluous words and phrases, immaterial detail, and repetitious statements.

Note Condor style and usage. "General Articles" and the "Field and Study" items are set up in different form. Provide a concise, meaningful title, and, where needed, subtitles within the text. Footnotes are not used. The address line may serve to indicate institutional connection, and to it should be added the date of transmittal of the manuscript. Terminal bibliographies are desirable where five or more titles are to be cited; otherwise, the references may be included in the text. For bibliographic style, note closely the practices employed in recent volumes of the journal. A factual summary is recommended for longer papers.

Rules for copy.—(1) Typewrite material, using one side of paper only; (2) double space *all* material and leave liberal margins; (3) use 8½ × 11 inch paper of standard weight (avoid onion skin); (4) carbon copies are not acceptable; (5) place tables on separate pages; (6) number pages in upper right hand corner.

Illustrations.—Photographs should be glossy prints of good contrast. Make line drawings with India ink; plan linework and lettering for at least ½ reduction; do not use typewritten labels on the face of the drawing. Provide typed legends on separate sheets.

Helpful references on writing: Manual of Style, University of Chicago Press, and Rules of the Editorial Committee, University of California Press. On scientific nomenclature: A.O.U. Check-list (with supplements 19 through 28) and Pacific Coast Avifauna No. 27; authors are not required to follow either of these works.

THE EDITORS OF THE CONDOR.